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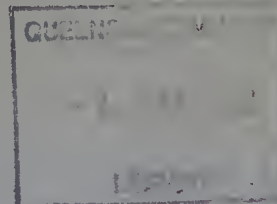
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Memoirs of the Queensland Museum.

VOL. X, PART IV.

Issued 30th JUNE, 1934.



EDITED BY THE DIRECTOR, HEBER A. LONGMAN, F.L.S., C.M.Z.S.



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TERTIARY FRESH WATER FISHES FROM SOUTHERN QUEENSLAND.

By EDWIN SHERBON HILLS, Ph.D.

(Plates XVIII-XXV; Text-figures 1-14.)

INTRODUCTION.—Fossil fishes have for a number of years been known to occur in Southern Queensland, in freshwater deposits which, with some reservations, are generally considered to be Tertiary (*see* Jones, 1926). No detailed account of them has, however, previously appeared, and interest attaches both to the recognition of the fossil species, as representatives of a former piscine fauna in Queensland, and to the possibility of their yielding more precise information as to the age of the beds in which they occur.

The bulk—39 specimens—of the material described below was collected by Dr. F. W. Whitehouse at Redbank Plains, from the two adjacent properties, Portion 172, Parish of Bundamba and Portion 37, Parish of Stapylton. In addition there are three fragments from Cooper's Plains, also collected by Dr. Whitehouse, one from a well in the Parish of Bundamba, and some crushed fragments from oil shales near Brisbane collected by Mr. L. C. Ball. I have also examined a specimen from Redbank Plains in the British Museum (Nat. Hist.), London, as well as two specimens from the same locality lent to me by the Geological Survey of Queensland. The present communication is therefore essentially a description of the fishes of the Redbank Plains Series. I have not seen the remains recorded by Dunstan (1901; 1916) from the Duaringa district, nor the Ceratodont tooth from Eight Mile Plains recorded by Jack and Etheridge as *Ceratodus forsteri* (1892, pp. 647, 740), these being the only other recorded examples of (?) Tertiary fresh-water fish in Queensland. David's reference (1932, Table I—Upper Oligocene) to the occurrence of "numerous fossil fish (*Epiceratodus*, etc.)" in the Oxley district refers doubtless to Redbank Plains. At Nimbin, in Northern New South Wales, there are freshwater carbonaceous shales presumably of Tertiary age, from which Smith Woodward (1902) has recorded *Ctenolates avus* Woodward, the only other record of a freshwater fish from the Tertiary of Australia known to me.

Systematic Descriptions.

Subclass **DIPNEUSTI.**

Order SIRENOIDEI.

Family CERATODONTIDÆ.

Genus **EPICERATODUS** TELLER, 1891.

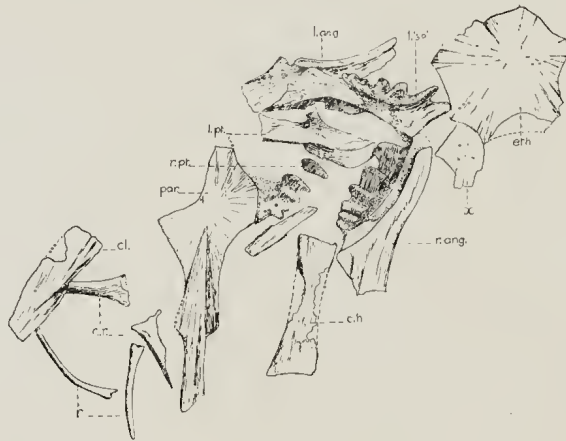
EPICERATODUS DENTICULATUS sp. nov.

(Text-figures 1 and 2.)

Locality.—Redbank Plains.

Material.—[RP/E]* Five specimens preserved as moulds in concretionary limonitic mudstone. Holotype. No. 1.

Description.—Both the palatine and “splenial” dental plates are separate, and bear five well-defined comb ridges, and what may be a sixth, ill-defined, posteriorly. The ridges are striated parallel to the edge of the plate, and on a few of them, but not all, four or five denticles are present on the outer edge. The left “splenial” plate in specimen No. 1 (see Fig. 1), is abnormal, the fourth comb ridge being atrophied.



Text-figure 1.—*Epiceratodus denticulatus* sp. nov. [RP/E] l. $\times \frac{1}{2}$ (approx.) No. F. 2347, Qld. Mus. Coll. Holotype. Drawn from a jelly mould. *ch*, cerato-hyal; *cl*, cleithrum; *c. r.*, cranial ribs; *eth*, ethmoid (?); *l. ang.* left angular; *l. pt.* left palatine; *l. "sp."* left “splenial”; *par*, parasphenoid; *r.*, ribs; *r. ang.* right angular; *r. pt.* right palatine; *x*, dermal bone.

The bone labelled ethmoid (?) in Fig. 1 clearly belongs to the median series of dermal cranial bones, but does not match either the so-called ethmoid or the occipital in *E. forsteri* (Kreff). The degree of ossification throughout is the same as in the type species, and the skeletal elements preserved, including the scales, are indistinguishable from those of that species (see Text-figs. 1 and 2). In the tail, the axonosts are slender and hollow ended, and the basecosts, which are overlapped by the thin and flexible but unjointed dermatichia, are weakly developed.

* Letters in brackets refer to labels on the specimens. Letters above the line refer to the localities—thus RP = Redbank Plains, CP = Cooper's Plains; letters below the line refer to the genus—thus E = *Epiceratodus*, B = *Phareodus*, N = *Notogoneus*, and P = *Percalates*. Counterparts are marked *a*, *b*, respectively.

TABLE I.—THE SPECIES OF EPICERATODUS.

Species.	Age.	No. of Combs.	Denticles.	Size.	Remarks.
<i>E. forsteri</i> (Kreffft) 1870	.. Pleist.—Recent	(5)–7	—	Medium	Living
<i>E. palmeri</i> (Kreffft) 1874	.. Pleist.	(?)	—	Large	Teeth only known
<i>E. gregoryi</i> White, 1925	.. Pleist.	7–8	—	Large	Teeth only known
<i>E. eyrensis</i> White, 1925	.. Pleist.	7–8	+	Medium	Teeth only known
<i>E. pattinsonae</i> White, 1926	.. Upper Cret.	6	—	Medium	Palatine tooth only known
<i>E. denticulatus</i> sp. nov.	.. Oligo.	5–(6)	+	Small	Teeth and other skeletal parts known



Text-figure 2.—*Epiceratodus denticulatus* sp. nov. Specimen in the British Museum $\times \frac{1}{2}$.
 ax, axonosts; ba, baseosts; de, dermatrichia; n. a., neural and haemal arches.

Remarks.—*E. denticulatus* is very close to *E. forsteri*. The presence or absence of denticles on the comb ridges is considered by Peyer (1925, p. 13) not to be a feature of classificatory importance, as they may be present or not, in what is regarded as the same species. Such is the case with *C. africanus* Haug, and *C. runcinatus* Plieninger. In *E. forsteri*, however, although the outer edges of the combs are somewhat serrated, no well-defined denticles are present. With regard to the number of comb ridges, Longman (1928) has recorded an aberrant example of *E. forsteri* possessing only five, but the possibilities are that in *E. denticulatus* the smaller number was the rule, and

not the exception. From *E. pattinsonae* the species is distinguished principally by the possession of narrower comb ridges, of a stouter first comb ridge on the splenial plate, and by the fact that the valley separating the first from the second comb ridge on the palatine tooth is shorter than the others in *E. pattinsonae*, while this is not the case in *E. denticulatus*. The distinctions from the other known species may be gathered from the Table given above. Sufficient is not yet known of the anatomy of fossil Ceratodontidæ to clearly indicate genetic affinities, and it is to be hoped that further material will be obtained from Redbank Plains, where parts other than the teeth are found in a good state of preservation.

Super Order **TELEOSTEI.**

Order **ISOSPONDYLI.**

Family **OSTEOGLOSSIDÆ.**

Genus **PHAREODUS** LEIDY, 1873.

PHAREODUS QUEENSLANDICUS sp. nov.

(Plates XVIII-XIX; Text-figures 3-7.)

Localities.—Redbank Plains and Cooper's Plains.

Material.—[RP/B]. Thirteen specimens preserved as moulds in concretionary limonitic mudstone. Holotype, No. 7, *a*, *b*.

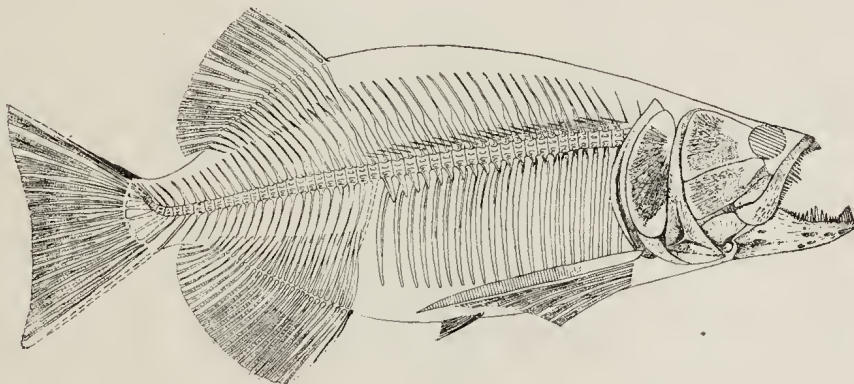
[CP/B]. Two specimens preserved as moulds in clay shale.

Description.—Moderately large fishes, estimated maximum known length about 0.5 metres. The body is less elongated than any of the living genera, resembling that of *P. acutus* Leidy, although not so deep or so blunt-snouted. The dorsal and anal fins are opposed, the dorsal somewhat shorter than the anal. The caudal is probably slightly excavated. The first pectoral ray is enormously elongated, reaching back beyond the pelvises, which are small and approximately mid-ventral.

The exact number of vertebrae is uncertain, but there are approximately 23 abdominal and 26 caudal, the last three, possibly four, being turned up into the tail. The vertebrae are ossified radially into strong longitudinal laminae. There are short parapophyses, which diminish in size anteriorly, on the posterior abdominal vertebrae. The neural spines are expanded at their bases into laminae in the median plane. Epineurals are present, but no epipleurals. The ribs are long and stout.

The anal fin is composed of 26 jointed rays, each supported by a baseoste, and there are two or three anterior spines. The dorsal has probably about 19 jointed rays, and, by analogy with the anal and with *P. acutus*, probably one or more small anterior spines. Each ray corresponds to a baseoste. The

caudal has about 16 jointed rays, and, to judge from the greater size of these dorsally and ventrally, was excavated at its posterior margin, which is not clearly shown in any specimen. The rays are supported by an uncertain number of hypurals. The hæmal spine attached to the seventh vertebra from the tip of the column is stronger than the others, and probably supported a robust ray or perhaps a spine in the caudal fin. There is no evidence that the enlarged first ray of the pectorals was serrated on its inner edge as Jordan (1905, p. 56) states to be the case in *P. acutus*. The pelvics have a small

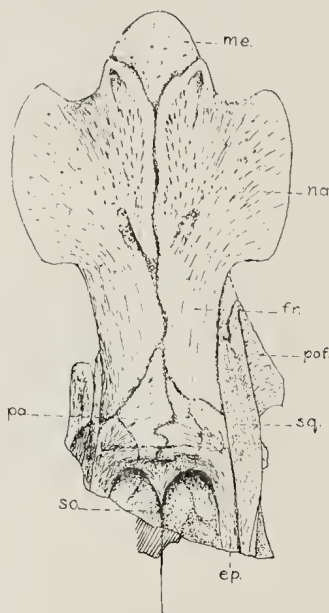


Text-figure 3.—*Phareodus queenslandicus* sp. nov. Partial reconstruction, based on Specimens [RP/B] 10, 7, 2, and [CP/B] 1.

anterior spine. The scales are of the typical Osteoglossid type, being large, granulated on the exposed surface, and divided into a mosaic of compartments.

The dermal cranial bones are sculptured, the operculum and post orbitals with grooves radiating from the growth centres and separated by rows of tubercles and fused tubercles. The cranial roof is ornamented with lineally arranged pits and grooves. The dentary is somewhat rugose. The cranial roofing bones (Fig. 4) are firmly sutured, but the sutures cannot all be made out, as in places the bones are cracked and it is difficult, from the impression, to distinguish between cracks and sutures. Comparison with the skull roof of *P. acutus* (see Plate XIX, Fig. A) and with Ridewood's figures (1905) of *Scleropages*, *Heterotis*, and *Arapaima*, brings out the close resemblance to *Phareodus*, and what is known of *Brychaetus* (see Smith Woodward, 1901, Plate I) shows that there is a general resemblance to that genus also. In the fossil genera the broad lateral and anterior expansion of the nasals and frontals, and the development of the oeciput are comparable and among the living forms, the closest resemblance is with *Scleropages*. In *P. queenslandicus* no suture is visible between the nasals and frontals, and that between the frontals and parietals is more anteriorly directed than in *P. acutus* or *Brychaetus*.

The opercular series consists of a large, sub-semicircular, radially sculptured operculum, the anterior part of which is overlapped by the expanded vertical limb of the pre-operculum, and there is a sub-operculum present. The



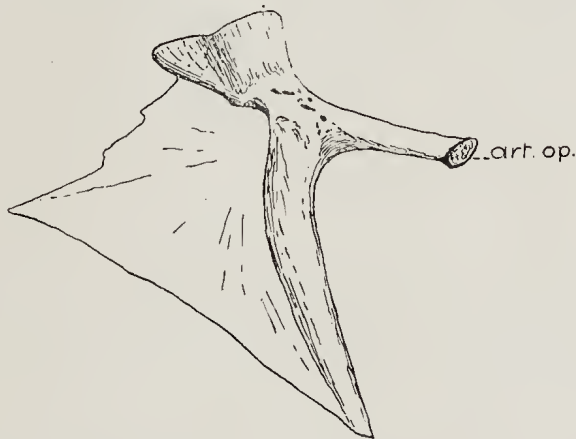
Text-figure 4.—*Phareodus queenslandicus* sp. nov. [RP/B] 2b. $\times 1$. Cranial roof. *ep*, epiotic; *fr*, frontal; *me* mesethmoid; *na*, nasal; *pa*, parietal; *pof*, post-frontal; *so*, supra-occipital; *sq*, squamosal.

two large sculptured post orbitals overlap the vertical limb of the pre-operculum. The lower post orbital is smaller than the upper. These bones are longer than



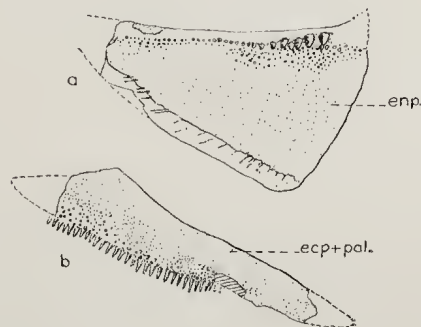
Text-figure 5.—*Phareodus queenslandicus* sp. nov. [RP/B] 1o. $\times \frac{2}{3}$. Left pre-operculum, outer aspect.

in *P. acutus* and resemble those of *Scleropages leichardti* Günther. Much of the quadrate appears to have been visible from the outside, and to judge from Tanner's figures (1925) this seems also to have been the case in *P. acutus*. The premaxilla is a small bone bearing a few large teeth, and the maxilla is large, a supplemental bone being apparently present, as in *Brychaetus*. The separate bones of the lower jaw cannot be clearly made out, but the jaw is strong and capable of a wide gape. The teeth are long, stout, hollow, and conical, those at the tip of the jaws and about the middle being larger than



Text-figure 6.—*Phareodus queenslandicus* sp. nov. [RP/B] lb. \times 1. Left hyo-mandibular, inner aspect. Art-op, opercular articulation.

the others. There are about 34 teeth on either side of the jaws, those near the angle of the gape being extremely small. The maxillary teeth are slenderer than those of the lower jaw.



Text-figure 7.—*Phareodus queenslandicus* sp. nov. a, [RP/B] 2a; b, [RP/B] 3. Right pterygoids and palatine, inner aspect \times 1. *ecp* + *pal*, fused ecto-ptyergoid and palatine; *enp*, ento-ptyergoid.

Teeth are present on the pterygoids, and the surface of these bones is covered with small tubercles. The teeth are short and stout on the entopterygoid, and slenderer on the fused ectopterygoid and palatine. The pterygoids greatly resemble the corresponding bones in *Scleropages leichardti* and differ from the other living genera (see Ridewood 1905). Teeth are not present on either the parasphenoid or the vomer.

Remarks.—Fossil remains of Osteoglossids are very rare, the only other occurrences being the well-known *Phareodus* spp. in the Eocene Green River shales of Wyoming, *Brychaetus* from the London Clay (and possibly the Oligocene of Germany (Zotz, 1928) and *Phareodus* from the lower Tertiary of Sumatra. The latter is an extremely interesting recent discovery, and Dr. de Beaufort, in a personal communication, states that the Osteoglossids from Sumatra (one large specimen and some smaller ones) are "very near *Dapedoglossus*" [*Phareodus*].

Eastman (1917, p. 288) states of *Phareodus acutus*, "Its primitive characters are evident, and among surviving genera the resemblance is closest to *Heterotis* of tropical Africa." I believe, however, that as Boulenger held (1922, p. 557) it is closest to *Scleropages*. In support of this the resemblances in the cranial osteology, which extend to the opercular series, post orbitals, jaws, pterygoids, and cranial roof, as well as the presence of the elongated first pectoral ray and the general shape of the body, are notable. As is the case with *Epiceratodus*, it seems that the fish living in Queensland represents a less differentiated survival than any other, of a previously widespread family.

Super Order **TELEOSTEI.**

Order ISOSPONDYLL.

Family GONORHYNCHIDÆ.

Genus **NOTOGONEUS** COPE, 1885.

NOTOGONEUS PARVUS sp. nov.

(Plate XX; Text-figures 8-9)

Locality.—Redbank Plains.

Material.—[RP/N]. Five specimens preserved as moulds in limonitic mudstone. Holotype, No. 4, *a*, *b*.

Description.—Small fishes, estimated maximum known length about 0.2 metres. The dorsal and pelvic fins are inserted slightly behind the middle of the fish, the dorsal just behind the pelvics; the caudal is excavated. The head is pointed, the mouth ventral, and the head and opercular apparatus are contained about four times in the total length of the fish to the tip of the tail. The length of the head exceeds the maximum depth of the body.

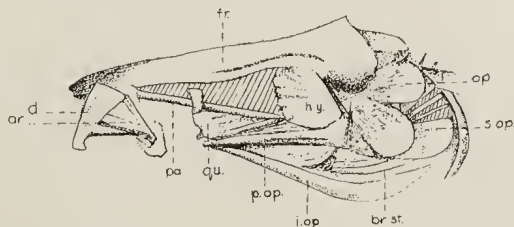
There are 14 caudal and 29 or 30 abdominal vertebrae, which bear a strong lateral ridge between deeply excavated dorsal and ventral hollows. The last vertebra is continued as a strong urostyle, to which is apposed a dorsal element covering the end of the spinal cord. There are 5 or 6 hypurals (see Fig. 8). The neural and haemal spines are slender, the ribs even more so. Intermuscular bones are present.



Text-figure 8.—*Notogoneus parvus* sp. nov. Detail of caudal fin. *a*, [RP/N] 3; *b*, [RP/N] 5; *c*, [RP/N] 4. \times about 2.

The caudal fin is slightly excavated at its posterior margin, and has about 24 jointed rays, with a few frenal spines. The number of rays in the other fins is uncertain, but there are approximately ten or eleven rays and 2 or 3 small anterior spines in the dorsal, seven rays in the pelves, and eight rays and 1 or 2 spines in the anal. The rays are supported by somewhat expanded basecosts.

The scales are typically Gonorhynchid in shape, being small, subrectangular, ornamented with concentric ridges, and possessing a raised posterior border, but close examination failed to reveal denticles such as are present in other *Notogoneus* species and in *Gonorhynchus*. Scales cover the operculum and pre-operculum, and traces of these can be seen on the frontals also, so that it is possible that the head was completely covered.



Text-figure 9.—*Notogoneus parvus* sp. nov. [RP/N] 4. \times 2. No. F. 2364, Qld. Mus. Coll. Holot; *pa*, articular; *b. st*, branchiostegal rays; *d*, dentary; *fr*, frontal; *hy*, hyo-mandibular; *i. op*, inter-operculum; *op*, operculum; *pa*, parasphenoid; *p. op*, pre-operculum; *qu*, quadrate; *s. op*, sub-operculum.

The operculum in one example (No. 4) bears three slits in its posterior border, in another (No. 2) four. These characteristics are regarded as of less than specific value, as no other significant differences are to be seen in the

various examples preserved. The notch in the operculum itself (*see* Fig. 9) is broader than in *N. osculus* Cope (*see* Smith Woodward, 1896) and the sub-operculum is overlapped by the operculum to a greater extent than in that species, and is also situated higher up on the head. The fact that the scales are still to be observed in this region indicates that any relative displacement of the bones has been small. The other cranial bones are very similar to those of *N. osculus* (*see* Smith Woodward, 1896 and the reconstruction given by Hussakof, 1908). There are a few broad branchiostegal rays. No teeth were observed in any part of the skull.

Remarks.—The above remains have been referred to *Notogoneus*, in spite of the absence of denticles on the scales, because of the resemblance of the cranial and axial skeleton to that genus. Better material may reveal differences sufficient to separate the Queensland remains from *Notogoneus*, but the affinities are certainly with it rather than with *Charitosomus*.

The recognition of the presence of a Gonorhynchid in fresh water Tertiary strata in Queensland is perhaps the most interesting result of the present investigation. *Gonorhynchus*, the only living genus of the family *Gonorhynchidae*, is exclusively marine, and restricted in its occurrence to the Indian Ocean and the Western Pacific. Of the already known fossil genera, *Notogoneus* (Upper Eocene to Upper Oligocene of Western Europe and Lower Eocene of Wyoming) is elsewhere chiefly or exclusively freshwater, and *Charitosomus* (Upper Cretaceous of Mount Lebanon and Westphalia) chiefly or exclusively marine. It is certainly unexpected to find *Notogoneus* also in Queensland, and even more so to find the association of *Phareodus* and *Notogoneus* in the lower Tertiary both there and in Wyoming.

Order PERCOMORPHI.

Family MORONIDÆ.

Genus **PERCALATES** RAMSAY AND OGILBY, 1887.

PERCALATES ANTIQUUS sp. nov.

(Plates XXI–XXIV; Text-figures 10–13)

Locality.—Redbank Plains.

Material.—[RP/P]. Nineteen specimens preserved in concretionary limonitic mudstone. Holotype, No. 5 *a, b*.

Description.—Medium sized fishes, estimated maximum known length 0.25 metres. The dorsal surface from in front of the spinous dorsal to the tip of the snout is slightly concave, and the maximum depth of the body is just in front of the spinous dorsal.

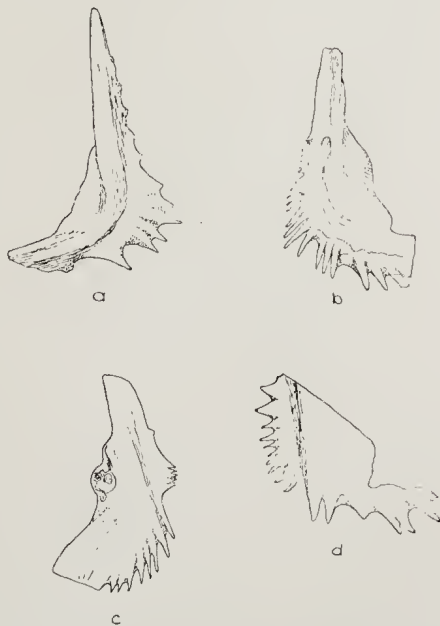
There are 30 vertebrae, 12 abdominal and 18 caudal, which are hollowed out dorsally and ventrally, leaving a strong lateral lamina. In one specimen (No. 5) the mid-caudal vertebrae are compressed, but the number remains constant (see Plate IV). The posterior ribs are attached to stout parapophyses.

There are eight spines in the spinous dorsal, the fourth being the longest. No gap separates the soft and spinous dorsals, and the soft dorsal has one anterior spine, slightly longer than the last in the spinous dorsal, and 11 or 12 jointed rays. The interneurals are laminate. The anal fin has three spines, one small anteriorly and the other two subequal and strong, and there are 9 jointed rays. In the caudal (Fig. 10) there are 17 or 18 jointed rays, with small fulcral spines dorsally and ventrally. The pelvics have a single anterior spine. The scales are moderately large, (25 in transverse series), ctenoid over



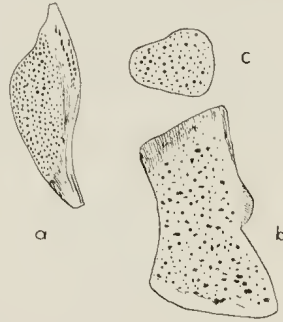
Text-figure 10.—*Percalates antiquus* sp. nov. [RP/P] 9b. $\times 2$. Detail of caudal fin.

most of the body, and cycloid on the opercular apparatus. The ctenoid scales are subrectangular and the cycloid are subcircular. Both the opercles and cheeks are scaly.



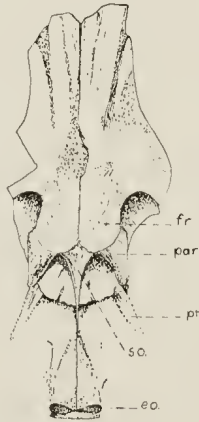
Text-figure 11.—*Percalates antiquus* sp. nov. Pre-opercular bones. a, [RP/P] 15; b, [RP/P] 13; c, [RP/P] 1; d, [RP/P] 16 \times about 1.

The cranial bones do not differ markedly from those of the living *P. colonorum* (Günther). The pre-operculum is spinous, the spines on the lower limb antrorse, but exhibiting great variations (see Fig. 11). The operculum has two spines. The upper and lower pharyngeals (see Fig. 12), the vomer, palatines, premaxillæ, maxillæ, and dentaries bear villiform teeth. The maxilla has a supplemental bone. The sub-orbitals are serrated. The skull roof is simple, and differs little from that of *P. colonorum*. The parietals, which are



Text-figure 12.—*Percalates antiquus* sp. nov. *a*, right lower pharyngeal [RP/P] 7b, $\times 3/2$; *b*, *c*, upper pharyngeals; *b*, [RP/P] 12; *c*, [RP/P] 7a.

separated by the supraoccipitals, apparently extend round the sides of the frontals more than in that species. There are (?) six branchiostegals. The mouth is large and protrusible (see Plate XXI).



Text-figure 13.—*Percalates antiquus* sp. nov. [RP/P] 17a. $\times 1$. Roof of skull. *eo*, ex-occipital; *fr*, frontal; *par*, parietal; *pt*, post-temporal; *so*, supra-occipital.

Genus **PERCALATES** (?) RAMSAY AND OGILBY, 1887.

Locality.—Oil shales, West of Strathpine and East of Bald Hills, near edge of Bald Hills basin.

Material.—Fragmentary remains very much crushed. The bone is preserved in a friable condition in black carbonaceous shale.

Description.—All that can be made out is that the remains are those of a Percoid fish, the spinous dorsal, pre-operculum with spinous border, and scales with concentric and radial ornament suggesting that, in view of the probable freshwater nature of the deposit, the remains may be those of *Percalates*.

Order PERCOMORPHI.

Family MORONIDÆ.

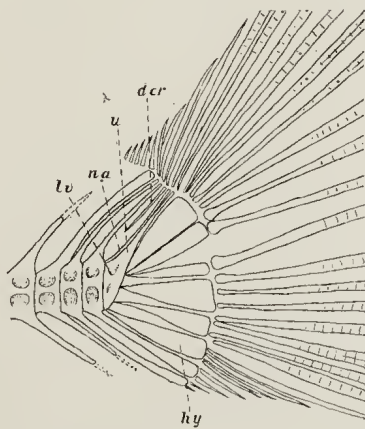
GENUS Indet.

(Plate XXV; Text-figure 14.)

Locality.—Well, Portion 122, Parish of Bundamba.

Material.—Posterior half of a very small fish, the bones replaced by translucent material (?) chalcedony) and preserved in fine shale.

Description.—The estimated length of the fish is about 5 centimetres.



Text-figure 14.—Percoid fish, genus indet., from well, Portion 122, Parish of Bundamba. $\times 4$. Detail of caudal fin.—*d. cr.*, dorsal caudal radials; *hy*, hypural; *l. v.*, last vertebra; *n. a.*, fused neural arches covering the posterior end of the spinal cord; *u*, urostyle.

The dorsal fin has 12 soft rays, the last two very small. The anal has three spines, one small anteriorly and two more, subequal and much stronger. The caudal has about 17 jointed rays and a series of dorsal and ventral fulcrul

spines: whether the posterior border was rounded or excavated is uncertain. There are at least 14 abdominal vertebræ, probably more, the last three compressed. The last vertebra is continued as a urostyle, to which is apposed a cover of fused neural arches, and there is a number of hypurals (*see* Fig. 13). The scales are ctenoid, and there are about 17 in a transverse series. Neural and hæmal spines are relatively strong.

Remarks.—In the absence of the head, the fish is indeterminable. It is not certain whether it is a pigmy perch or the fry of a large fish, but I incline to the view that the latter is the case and it may be that, as the general similarity suggests, it is a young specimen of *Percalates* sp.

This specimen was labelled "Ipswich or Upper Trias Jura." Mr. Ball points out, however, that when it was collected the Tertiary beds in the Bundamba district had not been mapped, and thus there is no necessary implication that the fish came from the Triassic Ipswich Series as now known. The well is situated within the Tertiaries, and from these the fish was obtained.

Order indet.

Locality.—Cooper's Plains.

Material.—A few fragments, the bone being actually preserved, in soft mudstone.

Description.—Fragments of the axial skeleton and fin spines of a Teleostean fish, indeterminable.

Remarks.—There is an extremely close resemblance between the fossil species *P. antiquus* and the living *P. colonorum*, the greatest differences being in the number of vertebræ—25 (11+14) in the living species and 30 (12+18) in the fossil—and the variability and less regular development of the spines on the pre-operculum of the fossil species. This close similarity is somewhat unexpected in view of the presence in the same beds of a distinct genus of Osteoglossidæ from that now living in the same region, and of the Gonorhynchid *Notogoneus*, of which no living relatives inhabit fresh waters.

It seems, however, that the more primitively organised Percoid genera such as *Percichthys* and *Lates*, have changed but little throughout Tertiary time. *Percichthys*, still living in South America, occurs fossil in the Tertiary lignites of Taubaté, Brazil (Smith Woodward, 1898), and *Cyclopoma* from the Upper Eocene of Monte Bolca, Italy, is scarcely distinguishable from *Lates*, still living in Northern Africa (Smith Woodward, 1901). *Percichthys* and *Percalates* are indeed extremely alike. Boulenger (1895) separates them in his key to the family Serranidæ [s. l.] solely on the presence of cycloid scales in *Percalates* as against ctenoid in *Percichthys*. The specimens of

Percalates in the National Museum, Melbourne, however, all possess delicately ciliate etenoid scales, and Ramsay and Ogilby in their definition of the genus, state that ciliated scales are present. A means of distinction must therefore be sought in other characters. The number of vertebræ, for instance, in the living species of *Percichthys*, varies from 33–35, as against 25 in *Percalates*, although it will be noted that the fossil *Percalates antiquus* approaches *Percichthys* in this respect, possessing 30 vertebræ.

GEOLOGICAL AGE OF THE FOSSIL BEARING BEDS.

Redbank Plains Series.—Of the forms occurring here, *Phareodus* is the most restricted in time, being found in the Lower Eocene (Paleocene) Green River Shales of Wyoming, and the (?) Eocene of the Padang Highlands, Sumatra. The age of the Sumatran beds is certainly Palæogene, if not Eocene (de Beaufort, 1931, and personal communication), but it may be that the Osteoglossids from there, at present referred to *Phareodus*, are really a new, though closely allied genus. *Notogoneus* ranges from the Paleocene (Green River Shales), through the Upper Eocene (Gyps de Montmartre) to the Lower Oligocene of Aix en Provence and the Upper Oligocene of the Mainz Basin. *Percalates*, by analogy with *Cyclopoma* [Lates] and *Percichthys*, may be expected to range throughout Tertiary time. *Epiceratodus* is known to occur in the Upper Cretaceous of White Cliffs, New South Wales, but *E. denticulatus* is much closer to the Pleistocene and Recent *E. forsteri* than is the Cretaceous species.

The evidence, therefore, is strong that the Redbank Plains Series is of Palæogene age—Eocene or Oligocene—certainly not Cretaceous, as has been suggested. Beyond that it is not possible to particularise with certainty, although if, as seems possible, *Phareodus queenslandicus* should prove to be closer to *Scleropages* than to the North American species, especially *P. acutus*, an Oligocene, rather than an Eocene age would be indicated, and this would be supported by the resemblance of *Percalates antiquus* to the living species, and of *E. denticulatus* to *E. forsteri*. The Redbank Plains Series may therefore be tentatively (in view of the paucity of comparative material) referred to the Oligocene, and with this Series the beds at Cooper's Plains (with *Phareodus* and other Teleosts) are clearly to be linked (see Jones, 1926).

Bald Hills Basin.—The evidence is insufficient to indicate more than that the oil shales with fragmentary fish remains are of Kainozoic age.

I am indebted to Mr. G. Mack, of the National Museum, Melbourne, for the opportunity of studying and dissecting specimens of *Percalates*, *Gonorhynchus*, *Scleropages*, and pigmy Perches in his care.

CONCLUSION.

In *Scleropages* and *Epiceratodus*, Queensland possesses two freshwater fishes whose only living relatives are found in parts of Africa, South America, and, in the case of *Scleropages*, in the East Indies. To account for such a peculiar distribution, land connections, either continuous at one period or progressively developed throughout the Tertiary, must be postulated. In older Tertiary times the freshwater fish faunas of North America and Europe were remarkably similar. The present communication has shown that in Australia, too, the lower Tertiary freshwater fishes conform, in a general way, to the types found in those continents, and in the East Indies. If the present and past distribution of freshwater fishes is considered, the case for the former existence of land connections, in moderately low latitudes, between the chief continental masses is greatly strengthened. The evidence of the Redbank Plains fishes is particularly clear as to the existence of a pre-Oligocene land connection, bridging the Pacific Ocean, between Eastern Australia and North America.

KEY TO LETTERING USED IN THE PLATES.

<i>a</i>	.. anal fin.	<i>p. ab.</i>	.. post abdominal bone (s).
<i>ar(t)</i>	.. articular.	<i>par.</i>	.. parasphenoid.
<i>b. r.</i>	.. branchiostegal rays.	<i>p. b.</i>	.. pelvic girdle.
<i>ch(y)</i>	.. cerato-hyal.	<i>pel.</i>	.. pelvic fin
<i>c(f)</i>	.. caudal fin.	<i>p. f.</i>	.. pectoral fin.
<i>cl.</i>	.. cleithrum.	<i>p. mx.</i>	.. pre-maxilla.
<i>d(en)</i>	.. dentary.	<i>p. o. 1, 2</i>	.. first and second post-orbitals.
<i>d.f.</i>	.. dorsal fin.	<i>p. op.</i>	.. pre-operculum.
<i>eh(y)</i>	.. epi-hyal.	<i>pt.</i>	.. ecto-pterygoid.
<i>hyo.</i>	.. hyomandibular.	<i>qu.</i>	.. quadrate.
<i>fr.</i>	.. frontals.	<i>r. 1</i>	.. enlarged first pectoral ray.
<i>i. op.</i>	.. inter-operculum.	<i>s. d.</i>	.. spinous dorsal.
<i>m. pt.</i>	.. meta-pterygoid.	<i>so. d.</i>	.. soft dorsal.
<i>mx.</i>	.. maxilla.	<i>s. op.</i>	.. sub-operculum.
<i>op.</i>	.. operculum.		

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EXPLANATION OF PLATES XVIII-XXV.

PLATE XVIII.

Phareodus queenslandicus sp. nov. [RP/B] 7a. Slightly reduced. No. F. 2357, Queensland Museum Collection. Holotype.

PLATE XIX.

A. *Phareodus acutus* (Leidy). Roof of skull, to be compared with Text-figure 4. (From Eastman, 1917, Pl. 16.)

B. *Phareodus queenslandicus* sp. nov. [RP/B] 10. $\times \frac{2}{5}$. No. F. 1960, Queensland Geological Survey Museum Collection.

PLATE XX.

Notogoneus parvus sp. nov. [RP/N] 4a. $\times 2$. No. F. 2364, Queensland Museum Collection. Holotype.

PLATE XXI.

Percalates antiquus sp. nov. [RP/P] 5a. $\times \frac{3}{4}$. No. F. 2370, Queensland Museum Collection. Holotype.

PLATE XXII.

Percalates antiquus sp. nov. [RP/P] 11. $\times 1$. No. F. 2376, Queensland Museum Collection.

PLATE XXIII.

Percalates antiquus sp. nov.

A. [RP/P] 15. $\times 1$. No. F. 2380, Queensland Museum Collection.

B. [RP/P] 9b. $\times \frac{3}{4}$. No. F. 2374, Queensland Museum Collection.

PLATE XXIV.

Percalates antiquus sp. nov.

A. [RP/P] 1a. $\times 1$. No. F. 2366, Queensland Museum Collection.

B. [RP/P] 13b. $\times 1$. No. F. 2378, Queensland Museum Collection.

C. [RP/P] 13c. $\times 1$. No. F. 2378, Queensland Museum Collection.

PLATE XXV.

Percoid fish. Genus indet. from a well in Portion 122, Parish of Bundamba. $\times 5$. No. F. 1961, Queensland Geological Survey Museum Collection.

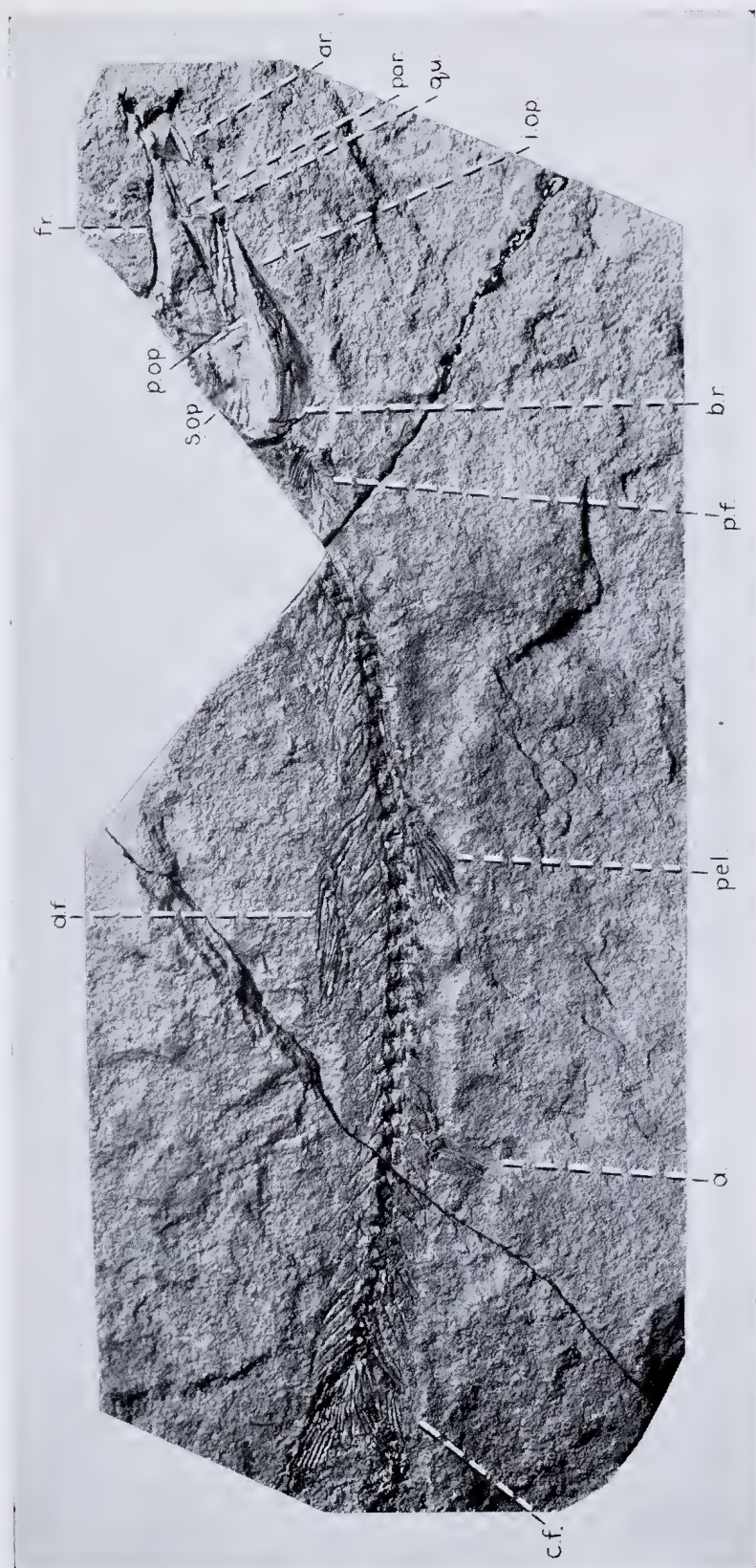


Phareodus queenstandicus sp. nov. [RP/B] 7a. Slightly reduced. No. F. 2357, Queensland Museum Collection. Holotype.



A. *Phareodus acutus* (Leidy). Roof of skull, to be compared with Text-figure 4. (From Eastman, 1917, pl. 16.)

B. *Phareodus queenslandicus* sp. nov. [RP/B] 10 × 3. No. F. 1960, Queensland Geological Survey Museum Collection.



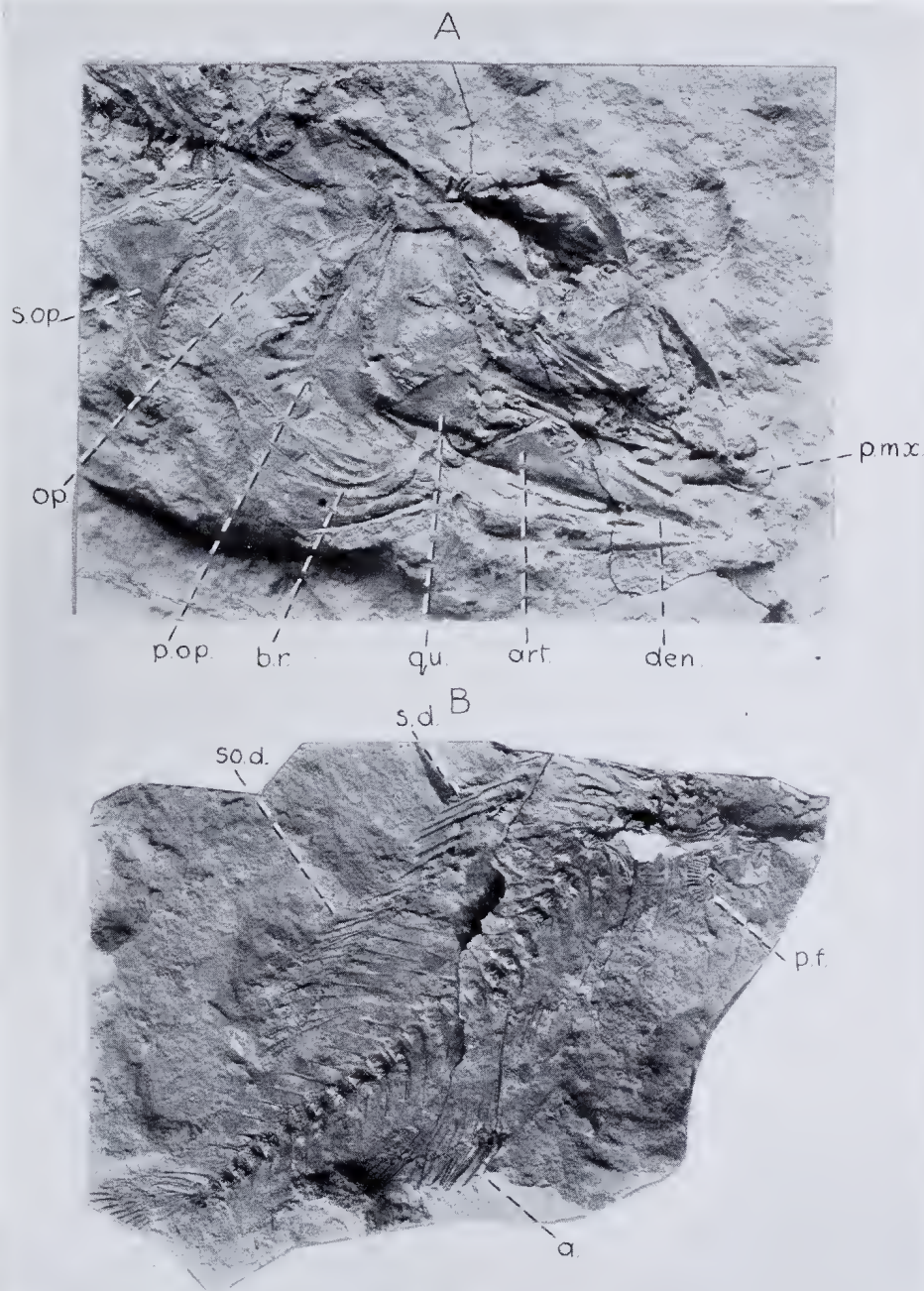
Notogoneus parvus sp. nov. [RP/N] 4a x 2. No. F, 2364. Queensland Museum Collection. Holotype.



Percalates antiquus sp. nov. [RP/P] 5a × $\frac{3}{4}$. No. F. 2370. Queensland Museum Collection. Holotype.

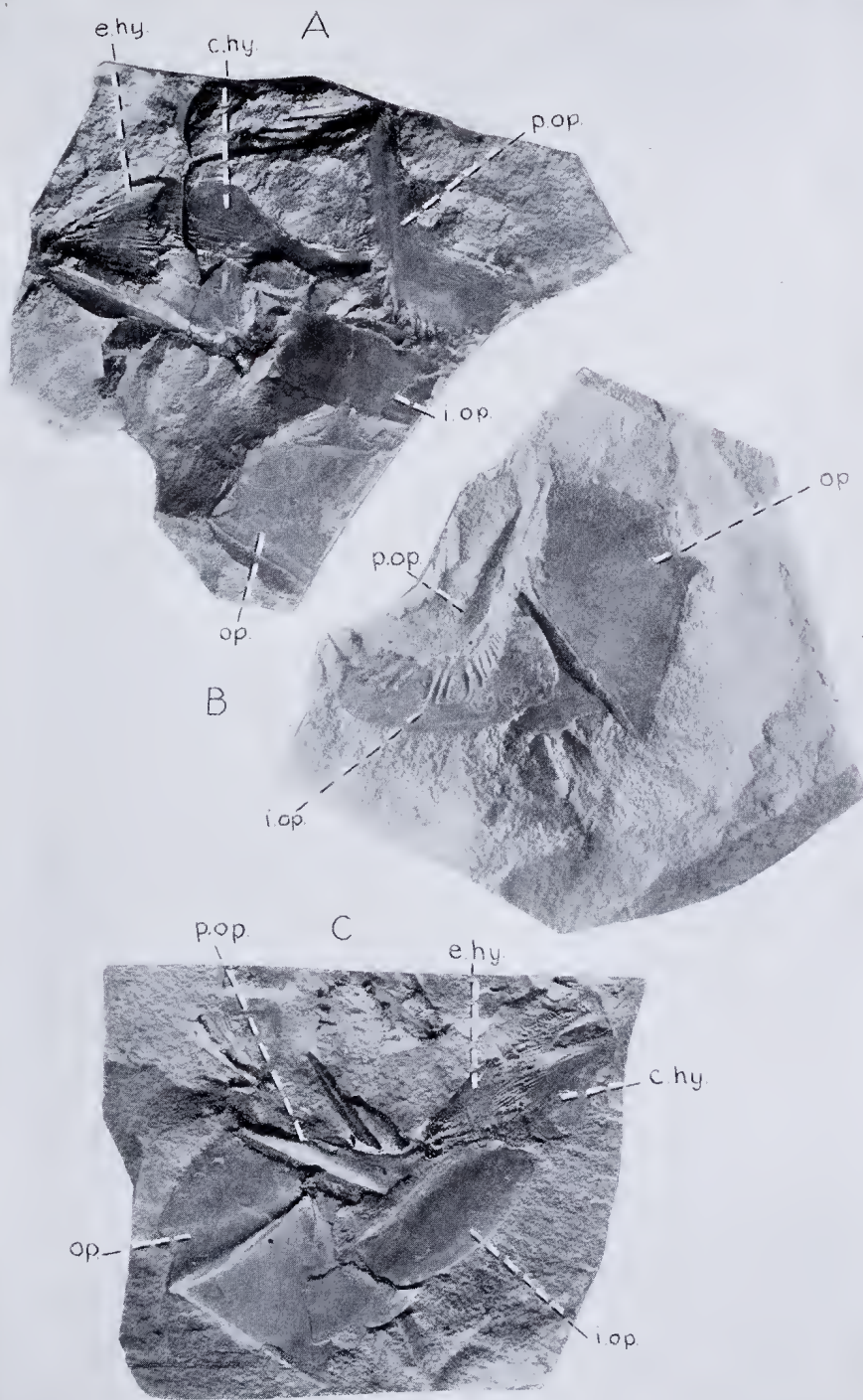


Perculatus antiquus sp. nov. [RP/P] 11 x 1. No. F. 2376, Queensland Museum Collection.

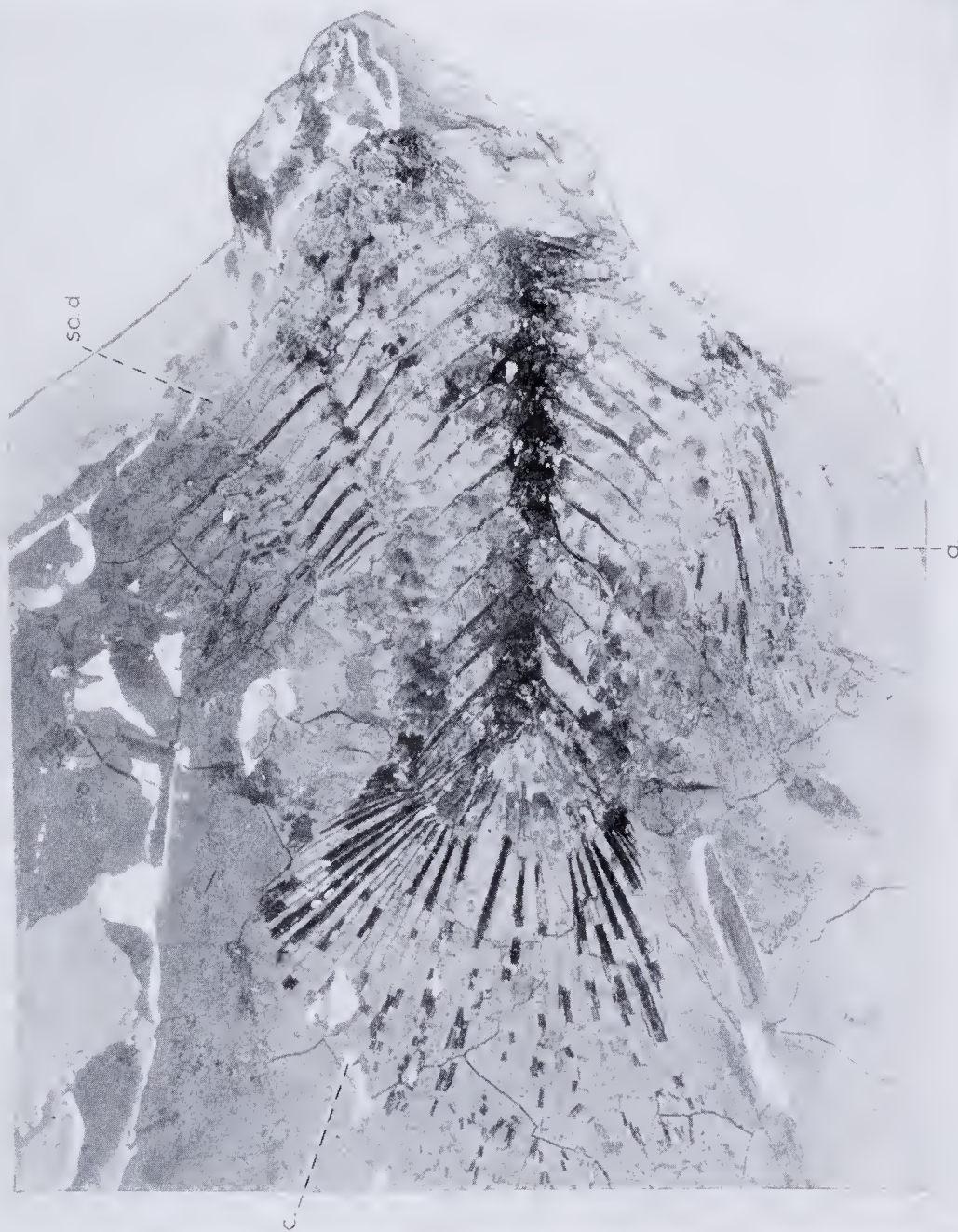


Percalates antiquus sp. nov.

- A. [RP/P] 15 × 1. No. F. 2380, Queensland Museum Collection.
 B. [RP/P] 96 × 3. No. F. 2374, Queensland Museum Collection.



Percalates antiquus sp. nov.
 A. [RP/P] 1a × 1. No. F. 2366. Queensland Museum Collection.
 B. [RP/P] 13b × 1. No. F. 2378. Queensland Museum Collection.
 C. [RP/P] 13c × 1. No. F. 2378. Queensland Museum Collection.



Percoid fish, genus indet., from a well in Portion 122, parish of Bundamba $\times 5$. No. F. 1961. Queensland Geological Survey Museum.

A NEW FISH, REPUTED TO BE POISONOUS, FROM QUEENSLAND.

BY GILBERT WHITLEY, ICHTHYOLOGIST, THE AUSTRALIAN MUSEUM, SYDNEY.*

(Plate XXVI; Text-Figure 1.)

There are few Australian fishes which, when eaten fresh, are poisonous as food. Toadfishes of the family Tetraodontidæ and Poreupine Fishes are well known as poisonous fishes so that nowadays few persons try to eat them, but there are other fishes, allied to the Hussars (family Lutjanidæ), the Snappers of our tropical waters, whose flesh is at times edible and at other times very poisonous.

At the beginning of the seventeenth century, the Spanish navigator, Pedro Fernandez de Quiros, remarked on poisonous Sparoid fishes of the Pacific¹ allied to the European *Pagrus*. Many years later, the naturalists on Cook's voyages, George Forster² and William Anderson³ also encountered these deceptive fishes, whilst Cook himself was severely poisoned through eating a toadfish in New Caledonia in 1774.

The Chinaman Fish of North Queensland, whose flesh, at certain unexplained periods, is poisonous, was earlier described in these Memoirs⁴, where it was named as a new genus and species, *Paradicichthys venenatus*. An account of its skull was later prepared by Dr. H. L. Kesteven, but this has not yet been published. Now, a second reputedly poisonous fish has been forwarded to me from Helix Reef, off Townsville, by the Queensland Museum, for identification and report. This is a species of Hussar or Sea Perch, known as the Red Bass, which, according to its donor, Mr. George Coates, "has the reputation of producing a form of muscular paralysis of a rather severe nature." Mr. Coates also remarks that "others of the same kind together with Chinaman fish have at various times been displayed for sale in the local fish shops." This fish is quite different from the Chinaman Fish (which has the soft dorsal

*(Contribution from The Australian Museum.)

¹ G. A. Wood, Discov. Austr. 1922, p. 470 and Stevens, New Light Discov. Austr. 1930, p. 127.

² Forster, Obs. Voy. World, 1778, pp. 201 and 642; Descr. Anim. (ed. Lichtenstein), 1844, pp. 254 and 282.

³ W. Anderson, Account Poisonous Fish, a letter dated 23 April 1776; also Cook, Voy. S. Pole, ed. 3, ii, 1779, p. 112.

⁴ Whitley, Mem. Qld. Mus. x, 1930, p. 13, pl. i, fig. 1. See also The Australian Museum Magazine, iv, 1932, p. 394, where Dr P. S. Clarke's notes, from the medical viewpoint, are reproduced.

fin much higher than the spinous, a shorter pectoral fin, smaller scales, more convex upper profile of head, no vomerine teeth and tail-fin not strongly forked), and belongs to a new species of the extensive genus *Lutjanus* which includes some excellent food-fishes.

Family LUTJANIDÆ.

Genus LUTJANUS Bloch, 1790.

LUTJANUS COATESI sp. nov. (Red Bass).

(Plate XXVI, fig. 2 and text-fig.)

Br. 6. D. X/14 (15); A. iii/9; P. i/16; V. i/5; C. 14.

L. Lat. 50; L. tr. 10/1/19 to 5/1/7 on caudal peduncle.

Head (194 mm.) 2.6 in length to hypural joint (514).

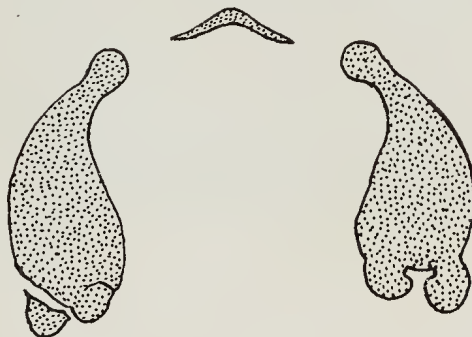
Eye (34) 5.7, snout (70) 2.7, maxillary (84) 2.3, preorbital (44) 4.4, interorbital (59) nearly 3.3, longest pectoral ray (138) 1.4, depth of caudal peduncle (60) 3.2, and fourth dorsal spine (61) nearly 3.2 in head.

Head rather long and somewhat pointed, its upper profile convex. Eye large, apparently resting on a subocular shelf; interorbital broad, convex over the eyes and flattened above. A conspicuous fossa before the eye extends to the nostrils, of which the posterior are sunken and with an oval outline, and the anterior rounded and with a short tube-like rim. Preorbital deep. Preoperculum serrated and with a distinct, though not large, notch to receive the knob over the interoperculum. Operculum entire, with a weak flat spine at its angle, where there is a narrow opercular flap. Interoperculum entire, its margin undulating and with a single frill where it joins the chin. The head is naked except for two rows of scales on the nape and sealy areas on the preoperculum, interoperculum, and operculum. These opercular scales are bilaterally asymmetrical in the specimen before me, the left side of the head having evidently been damaged at some time. On the right side, there are up to seven more or less upright rows on the preoperculum and slightly more on the operculum. The naked upper part of the head bears minute granular papillæ and the tips of the jaws are rugose.

Jaws subequal, the lower slightly protruding. Maxillary partly sheathed by preorbital, without supplemental bone, its extremity truncate, with rounded angles and reaching below anterior margin of eye. Mandibles with an arched ascending ramus.

The dentition is very strong yet partly concealed by the coriaceous lips. A small curved canine on each side of the premaxillary symphysis is followed by another nearly twice as long, then, after a short gap, comes a single row of short, strong, pointed teeth along each side of the upper jaw; none of

the teeth directed outward. Behind these teeth are broad bands of rough villiform teeth which extend right across the symphysis. In the lower jaw the teeth are caniniform on each side of the mandibular symphysis, followed by two large canines (not quite so long as the longest pair in the upper jaw) and a single row of sharp pointed teeth. Behind these are bands of villiform teeth as in the upper jaw. A wide Δ -shaped band of villiform teeth on the vomer, without a median posterior shaft, and patches of rougher villiform teeth on the palatines, which are shaped as in the accompanying figure. A buccal flap present in each jaw. Palate longitudinally plicate. Tongue large, fleshy, rounded, without teeth.



Text-figure 1.—*Lutjanus coatesi*, sp. nov. Palatal dentition of Holotype. Natural size.

As the specimen has been gutted and cleaned, no details can be given concerning branchial arches, gillrakers, stomach contents, sex, etc. Pseudo-branchiae are present.

Body robust, its depth subequal to length of head or about one-third of the standard length but accurate measurement is impracticable. Large, regular, weakly ctenoid or ciliated scales cover the body and extend over the breast and onto the bases of all the fins except the spinous dorsal and the ventrals. Scales have 12 to 15 basal radiating striae, central portion rather like ground glass, circuli fine, apical denticles numerous and becoming frayed at edge of scale. An axillary ventral scale. Fifteen predorsal scales, which do not reach the level of the eyes, and about fifty scales with obsolescent tubes on the lateral line, which ceases at the root of the caudal fin. The scale-rows all slope obliquely upwards and backwards above the lateral line but run in a longitudinal direction below it. Suprascapular denticulations obsolete.

Dorsal fins continuous but notched, the fourth or fifth spines were probably the longest, but the fifth appears to have been damaged and is shortened in this specimen. The base of the spinous dorsal is longer than that of the soft, which has a rounded margin; none of the rays is as long as the longest dorsal spine. Anal commencing below anterior dorsal rays, its base is shorter than that of the soft dorsal. Second anal spine very thick but not so long as third; the anterior anal rays are about twice as long as the

posterior ones, none of which is produced. Pectoral broad and slightly falcate, the fifth ray longest and reaching to the level of the anal origin. Ventrals considerably shorter than pectorals and barely reaching vent. Caudal forked, almost entirely covered by scales.

Colour.—Mr. T. C. Marshall, of the Queensland Museum, made notes on the colours of the fish when it arrived at Brisbane, frozen in ice, from Townsville, as follows:—

“General colour rose doree. Colour of the back along top of head to tip of snout victoria lake. The dark shades of the back merged laterally into rose doree passing into eosine pink on the belly. Operculum mars yellow fading on the ventral surface to strawberry pink, which is the same colour as the preopercle. Eye peach red encircled with narrow border of cadmium orange. Inside of mouth, vomer, palate, etc. cream white faintly tinged with pink. Spinous dorsal with the spines blackish flushed between with scarlet. Soft dorsal maroon with flushes of scarlet. Anterior half of pectorals maroon, and rose doree on their posterior half. Ventrals and anal rose doree basally, passing into blackish on their outer edges. Caudal darker rose doree somewhat narrowly edged with black. Head with several small wavy lines and blotches of dark lavender, thickest in the preorbital areas. Each body scale with a boomerang-shaped patch, lighter than surrounding colour giving the fish a decidedly spangled appearance.

Colours taken from Ridgway's Color Standards and Nomenclature, 1912.”

After preservation in formalin, the general colour is dull greyish becoming whitish or yellowish on sides of head and body. Fins dark greyish, the lower parts of the pectorals and ventrals white. Inner axil of pectoral orange, or yellow, meeting the blackish dark area on the rays. Eye bluish. Teeth and inside of mouth white. The scales of the upper part of the body each with a pearly central spot. These spots form rows on the sides, until, towards the belly, the light areas form bands which are broader than their greyish interspaces. No dark blotch on sides below dorsal fin.

Described and figured from the holotype of the species, a specimen 514 mm. in standard length or rather more than two feet in total length.

Locality.—Helix Reef off Townsville, North Queensland. Presented by Mr. George Coates. Queensland Museum regd. no. I. 4977.

Affinities.—This species does not seem to agree with any in Bleeker's “Atlas Ichthyologique” or in Fowler's recent key.⁵

⁵ Fowler, Bull. U. S. Nat. Mus. 100, xi, 1931, p. 86.



Fig. 1. The Chinaman Fish. *Paradicichthys venenatus* Whitley. Holotype.



Fig. 2. Red Bass, *Lutjanus coatesi* Whitley.
Reduced to the same scale, from preserved specimens, for comparison.

Photographs: G. C. Clutton.

Face page 178.

The *Diacope rivulata* of Cuvier and Valenciennes⁶ with second anal spine longer than the third, more elevated soft dorsal fin and several rows of nuchal scales and different coloration is only superficially similar; moreover, specimens from Port Moresby and the Andaman Islands in the Australian Museum have more strongly denticulated preoperculum and narrower bands of palatine teeth, also a prominent silver spot below dorsal fin.

Ogilby⁷ recorded *Lutjanus gibbus* (Forsk.) from the "Torres Group" and his specimen may belong to this new species.

The Australian Museum has specimens labelled as *Lutjanus gibbus* (mostly small) from Samoa; Funafuti, Ellice Group; Hog Harbour, New Hebrides; and Port Moresby, New Guinea. These have the eye comparatively larger, preopercular notch deeper, and upper profile of head much less convex than in my new species. The lower jaw is included, and the specimens in general resemble Day's⁸ figure of an adult, less than one foot long. The species was originally briefly described as "*Sciæna gibba*" by Forskal⁹ from the Red Sea, as being red, with white spots on the scales and the back gibbous, etc.

Through the courtesy of Mr. John Shewan, Curator of the Macleay Museum, the University of Sydney, I have been enabled to examine the type-specimens of several of Sir William Macleay's species of *Mesoprion* and *Genyoroge* (= *Lutjanus*, *sensu latissimo*) for comparison with the new species.

Mesoprion obscurus Macleay, from the Endeavour River, has the pre-operculum scarcely notched, body crossed by 9 or 10 dark bands, and some silvery streaks below eye.

M. roseigaster Macleay, from Rockingham Bay, has deeper form, Sc. 40, eye large, and no fossa between it and nostrils.

M. bidens Macleay, from New Guinea, has the preoperculum triangularly gashed to receive the interopercular knob, a broad patch of vomerine teeth, and Sc. about 50, the scale rows ascending obliquely both above and below the lateral line.

The types of *Genyoroge unicolor* Alleyne and Macleay, from Percy Islands, Queensland, are small specimens, yet they bear a superficial resemblance to my new species, which might well be identified as *unicolor* from the original figure. However, the actual specimens have more than 50 transverse scale-rows which ascend obliquely both above and below the lateral line, an increased number of nuchal scales, vomerine teeth in a broader triangular band, and palatine teeth in a narrow strip, whilst the second and third anal spines are subequal. As the name *unicolor* was anticipated by Castelnau, I renamed this species *Lutjanus castelnaui* in 1928.

⁶ Cuvier and Valenciennes, Hist. Nat. Poiss. ii, 1828, p. 414, pl. xxxviii. Coromandel, etc.

⁷ Ogilby, Ann. Qld. Mus. ix, 1908, p. 5.

⁸ Day, Fish. India, 1875, p. 43, pl. xiii, fig. 2.

⁹ Forskal, Deser. Anim. 1775, p. 46.

NOTES ON SOME AUSTRALIAN SHARKS.

BY GILBERT WHITLEY, ICHTHYOLOGIST, THE AUSTRALIAN MUSEUM, SYDNEY.*

(Plates XXVII-XXIX; Text-figures 1-4.)

The study of sharks is of considerable interest and importance from many points of view. To most persons sharks are noteworthy on account of their size, ferocity, and the fact that they attack human beings from time to time¹. No practical scheme for combating the shark menace has yet been evolved. Nets and fences enclosing small bathing areas are best, but hooters and alarms given from a lookout on a tower, or, more recently, coloured lights fired from aeroplanes, are the usual form of warning in open waters.

The biologist sees in the sharks a group of animals quite distinct from ordinary fishes and occupying a unique position in the vertebrate series. Their general physiology and their breeding habits, ranging from oviparous to viviparous, and the development in some forms of a structure foreshadowing the placenta of higher animals, are of the highest interest. Their relationships with fossils, and the general antiquity of the group allow the palæontologist to visualise the original appearance of the remains of long extinct fossil species.

The bibliographer or historian will find many quaint legends and descriptions of sharks in old books of travel, natural histories, and other literature.

Sharks are of considerable commercial value both as food and for their by-products so that any attempt to clarify the study of them may have a potential economic importance². They are usually caught by means of special nets or lines, but I have seen them experimentally killed by electrocution, a method which may be more extensively employed in the future.

The notes given in this paper are mainly in the nature of preliminary descriptions with figures of some Australian species. In the last twelve years I have studied many specimens both in the Museums of Australia and New Zealand, and in the field. I have corresponded widely with colleagues and card-indexed a large amount of literature. At some future time, I hope to prepare a "Shark Book" which will form a popular guide to all the Australian species, with a figure of each, for the use of the general public.

* By permission of the Trustees of The Australian Museum.

¹ See Coppleson, "Shark Attacks in Australian Waters," in *Medical Journal of Australia*, April 15, 1933, pp. 449-467, illustr.

² A sample of tanned shark skin was presented to the Australian Museum by a Mr. Horatio Tozer so long ago as 1858. A description of the latest methods of tanning is given by F. A. Coombs in "The Australasian Leather Trades Review," July 1928, pp. 13-19, illustr.

Family *HEPTRANCHIIDÆ*.Genus *NOTORYNCHUS* Ayres, 1855.**NOTORYNCHUS CEPEDIANUS** (Péron).

Squalus cepedianus Péron, Voy. Austr. i, 1807, p. 337 and Voy. Terres Austr. ed. 2, ii, 1824, p. 218. Adventure Bay, Tasmania (Baudin's expedition).

Notorynchus macdonaldi Whitley, Rec. Austr. Mus. xviii, June 29, 1931, p. 138, pl. xx, figs. 3-5. Manly, New South Wales. Type in Australian Museum.

I find that Péron named the south-eastern Australian Seven-gilled Shark *Squalus cepedianus*, so his name, published in 1807, and hitherto overlooked, must take precedence over my *macdonaldi*. It is also earlier than *Squalus platycephalus* Tenore 1810, which is generally regarded as the first-named seven-gilled shark referable to the genus *Notorynchus*. Though Péron gave sufficient characters for the recognition of his *Squalus cepedianus*, the same cannot be said of *S. rhinophanes*, which he named at the same time, and which I am unable to identify. Perhaps drawings of these Tasmanian sharks still exist amongst the Péron and Lesueur relics in the Havre Museum.

The seven-gilled shark is not uncommon around the North Island of New Zealand, and there is a skin, 9½ feet long, from Oriental Bay, in the Dominion Museum, Wellington. Mr. Phillipps tells me that the Maoris called it *Tuatini* and used its teeth to make a saw-like instrument (*Ripi* or *Mira Tuatina*) for cutting human flesh.

Family *HETERODONTIDÆ*.Genus *HETERODONTUS*, Blainville, 1816.**HETERODONTUS PORTUSJACKSONI** (Meyer).

(Plate XXVII, fig. A.)

Squalus portus jacksoni, Meyer, Zool. Entdeck. 1793, p. 71, Based on the Port Jackson Shark figured in Phillip's *Voyage*, p. 166, pl. 42.

Squalus jacksoni Suckow, Naturges. iv, 1799, p. 102 (*fide* Sherborn, Index Animalium). *Id.* Turton, Syst. Nat. (Linné), 1806, p. 922.

Squalus philippi Bloch and Schneider, Syst. Ichth. 1801, p. 134. "New Holland." Based on Phillip.

Squalus philippinus Shaw, Gen. Zool. v, 2, Pisc. 1804, p. 341. Latinization of "Squale philipp" of Lacépède. Botany Bay.

Squalus jacksonii Bullock, Companion Bullock's Mus. ed. 8, 1810, p. 60. "This is a new species, lately discovered in the harbour of Port Jackson, Botany Bay." Figured in the 1814 edition (Compan. London Mus. ed. 17, 1814, p. 90, pl.—, figs. 1-2.)

Acanthias philippi Eichwald, De Selachis, 1819, p. 67. *Ex.* Bloch and Schneider.

Cestracion heterodontus Sherrard. Illustr. Offic. Handbk. Aquar. &c., Melbourne, circa 1896, pp. 42 and 88, figs. . Hobson's Bay, Victoria.

Heterodontus philippi Ogilby. Mem. Qld. Mus. v, 1916, p. 82. Emended orthography.

The synonyms of the Common Port Jackson Shark are here tabulated for the first time. The earliest specific name appeared in Meyer's *Systematisch-Summarische Uebersicht der neuesten Zoologischen Entdeckungen in Neuholland*

und Afrika, where Phillips' illustration of "Lieut. Watts' shark" was also named *Squalus Wattsii*, but the latter name is a synonym of *Orectolobus maculatus* (Bonnaterre).

Genus *MOLOCHOPHRYS* Whitley, 1931.

MOLOCHOPHRYS GALEATUS (Gunther).

(Plate XXVII, fig. B.)

Cestracion galeatus Gunther, Cat. Fish. Brit. Mus. viii, 1870, p. 416. "Australia" (Dr. G. Bennett), probably from near Sydney, N. S. Wales.

Molochophrys galeatus Whitley, Austr. Zool. vi, 1931, p. 310.

The Crested Port Jackson Shark is here figured from a specimen trawled by the "Endeavour" in 35-40 fathoms off Sandon Bluff, New South Wales. In comparison, there is shown the common species (*Heterodontus portusjacksoni*), from a specimen caught at Manly, New South Wales. These beautiful illustrations were drawn by the late A. R. McCulloch, and indicate the differences between the two better than any previously published descriptions or figures.

Family *HEMISCYLLIIDÆ*.

Genus *BRACHÆLURUS* Ogilby, 1907.

BRACHÆLURUS WADDI (Bloch and Schneider).

Squalus waddi Bloch and Schneider, Syst. Ichth. 1801, p. 130, "New Holland" (Latham).

The *Squalus waddi* of Bloch and Schneider was briefly described:—

"*Squalus* corpore superius bruno, nigro fasciato, ventre flavicante, capite depresso, obtusiusculo, cirrhis nasalibus 2, dorso unipinnato, pinna remota, caudali longa, cauda longitudine ceteri corporis.

"Habitat circa novam Hollandiam, *Waddi* appellatus.

"Picturam Dr. Latham communicavit."

The type painting was evidently prepared from a specimen collected near Sydney, New South Wales, by Dr. Latham, and the description most nearly applies to the "Blind Shark," which was later called *Chiloscyllium modestum* by Gunther and *C. furvum* by Ramsay.

I may note here that Dr. Latham, who was a famous ornithologist, described our Saw Shark (*Pristiophorus cirratus*) in the Trans. Linn. Soc. London (ii, 1794, p. 281, pl. xxvi, fig. 5 and pl. xxvii) from Port Jackson. This species was named *Squalus anisodon* by Laéépède (Hist. Nat. Poiss. iv, 1802, p. 680), and *S. tentaculatus* by Shaw (Gen. Zool. v, 2, 1804, p. 359.)

Family *ORECTOLOBIDÆ*.

Genus *STEGOSTOMA* Muller and Henle, 1837.

STEGOSTOMA TIGRINUM (Pennant).

Squalus tigrinus Pennant, Ind. Zool. 1769, p. 24. India.

Squalus maculatus Bloch and Schneider, Syst. Ichth. 1801, p. 130. "Habitat in oceano orientali." Preoccupied by *S. maculatus* Bonnaterre, Tabl. Encycl. Meth. (Ichth). 1788, p. 8, which is the Australian Wobbegong (*Orectolobus*).

Stegostoma varium Garman, Mem. Mus. Comp. Zool. Harvard xxxvi, 1913, p. 59. Ex. "*Squalus varius*" Seba 1761, non. binom. East Indies, etc.

Stegostoma tigrinum McCulloch, Austr. Mus. Mem. v, 1929, p. 7 (synonymy). "Zebra Shark" Welsby, Sport and Pastime in Moreton Bay, 1931, p. 35. Rous Channel, Queensland.

There is a small skin in the Museum at Perth from Wyndham (West Australian Mus. regd. no. P. 1065). New record for Western Australia.

A fine specimen from Moreton Bay occupies a case in the Queensland Museum. A living example, evidently a straggler, was recently captured in Botany Bay, New South Wales, and kept in captivity.

The preoccupied name *Squalus maculatus* may now be added to the synonymy of this species.

Family GINGLYMOSTOMATIDÆ.

Genus NEBRODES Garman, 1913.

Nebrius Ruppell, Neue Wirbelth. Abyssin. Fische, 1837, p. 62. Haplotype, *N. concolor*, Ruppell. Preoccupied by *Nebria* Latreille, Sonnini's Buffon., Ins. iii, 1802, p. 89, a genus of Coleoptera, as noted by Müller and Henle (Plagiost. 1838, p. 22), under *Ginglymostoma*.

Nebrodes Garman, Mem. Mus. Comp. Zool. Harvard xxxvi, 1913, pp. 43 and 56. Logotype, *N. concolor* (Ruppell).

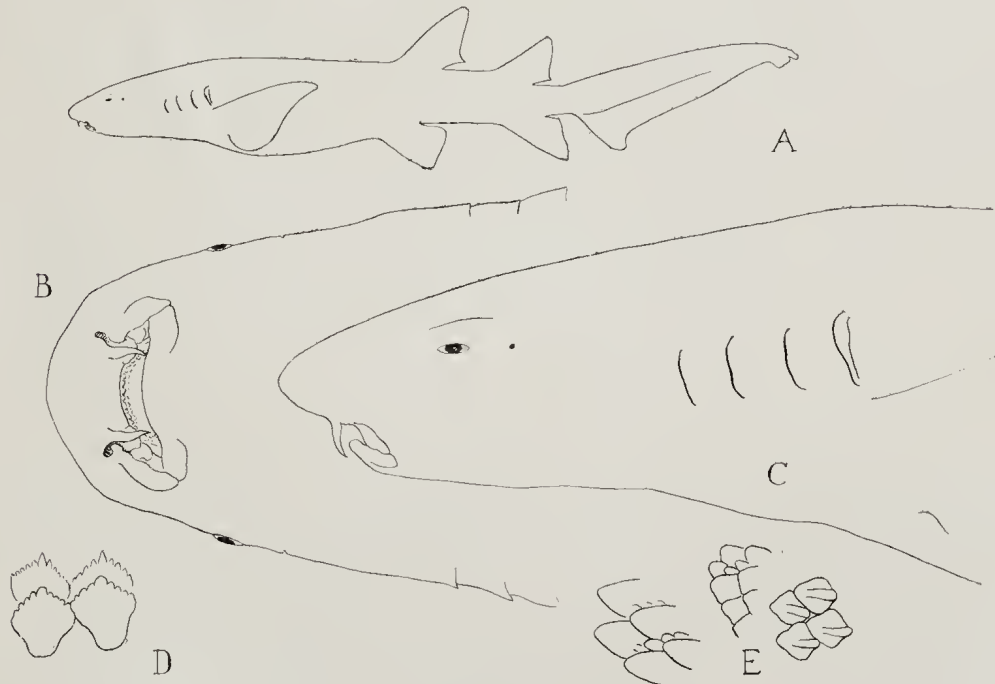
NEBRODES CONCOLOR OGILBYI, subsp. nov.

(Text-figure 1.)

Nebrius concolor Ruppell, Neue Wirbelth. Abyssin. Fische, 1837, p. 62, pl. xvii, fig. 2. Massowah, Red Sea. Not *Nebria concolor* Dejean, Catal. Coleopt., 1821, p. 7, a *nomen nudum* in Coleoptera (*vide* Sherborn).

Ginglymostoma concolor Macleay, Proc. Linn. Soc. N. S. Wales, vii, April 1883, p. 597, Port Moresby, New Guinea.

Nebrius concolor Ogilby, Mem. Qld. Mus. ii, 1913, p. 90, *et ibid* iii, 1915, p. 130; v 1916, p. 75 (Darnley I., Queensland).



(Text-figure 1.)

Nebrodes concolor ogilbyi Whitley.—Holotype of subspecies from Darnley Island, Queensland. Qld. Mus. regd. no. I 1216.—A, entire specimen, B ventral view of head, C lateral view of head, D teeth showing worn functional series, E various forms of dermal denticles. Gilbert Whitley del.

A large specimen of "*Nebrius concolor*," 955 mm. or a little over 3 feet long, from Darnley Island (Qld. Mus. regd. no. I 1216) resembles Ruppell's figure but has a longer snout, longer paired fins, and slight differences in dentition, nasal cirri, etc., wherefore, I give a figure of the Australian specimen, with a subspecific name in honour of the late James Douglas Ogilby, in appreciation of his "Check List" in these Memoirs (1916).

Family *CARCHARHINUS*.

Genus *CARCHARHINUS* Blainville, 1816, *sensu novo*.

Carcharhinus Blainville, Bull. Sci. Soc. Philom. Paris (Aug. 1816), p. 121; Journ. Physique, lxxxiii, 1816, p. 264 (*fide* Sherborn, Index Anim.). Logotype, *Squalus carcharias* Linné, designated by Bosc, Nouv. Dict. Hist. Nat. v, 1816, p. 277.

There has always been some confusion as to the correct application of the etymologically similar generic names *Carcharias*, *Carcharhinus*, *Carcharodon*, etc.

The generic name *Carcharias* was proposed by Rafinesque in 1810. I have not seen his original description, but Jordan and Evermann (Bull. U. S. Nat. Mus. xlvii, i, 1896, p. 33) show that *C. taurus* Raf. is the genotype, and this selection has been confirmed by the International Commission. Thus *Carcharias* is available for the Grey Nurse sharks.

Carcharhinus was the name given by Blainville to some fourteen species of sharks in 1816. Most authors have accepted *C. commersonii* Blainville as the genotype, but I find that Bosc (Nouv. Dict. Hist. Nat. v, 1816, p. 277) designated *Squalus carcharias* Linné as the type. Unfortunately, Blainville's works are not available to me, but it is now obvious that if he mentioned Linné's species in 1816, the Great White Shark *Squalus carcharias*, and not the Grey Shark, *Carcharhinus commersonii*, will be the genotype of *Carcharhinus*. This will cause *Carcharhinus* to be utilised for the White Shark usually known as *Carcharodon*. The name *Carcharorhinus* of Agassiz, 1846, being an emendation for *Carcharhinus* must also be transferred to the synonymy of the White Shark. The name was also spelt *Carcharinus* by Bory de St. Vincent (Dict. Class. iii, 1823, p. 203).

Carcharodon was proposed by Müller and Henle (Mag. Nat. Hist. (Charlesworth), new ser. ii, Jan. 1, 1838, p. 37), who quoted it from A. Smith's manuscripts. The haplotype is *C. capensis*, figured in Smith's Ill. Zool. S. Africa (iii, 1839, pl. iv.). This is a White Shark, generally regarded as a synonym of *Squalus carcharias* Linné (= *Carcharhinus carcharias*, according to the present showing).

Cuvier (Règne Anim. ii, Dec. 1816, p. 125) brought in *Carcharias* for *Squalus carcharias*, but his name is invalidated by Rafinesque's earlier use for the *taurus* type.

This problem has also been discussed by Fowler (Proc. Acad. Nat. Sci. Philad., 1908, p. 62), who has access to Blainville's paper, but was unaware of Bose's genotype designation. Fowler notes that *Carcharhinus commersonii* cannot be the type of *Carcharhinus* Blainville as it is a *nomen nudum*. The next of Blainville's names, *C. lamia* (Raf.) is a synonym of *Squalus carcharias* Linné, and this, Fowler considered, would be the type "which would upset *Carcharodon* of Smith, in which case I shall consider the *Squalus vulpes* Gmelin the type of *Carcharhinus* Blainville."

This would make *Carcharhinus* a synonym of *Alopias*, the Thresher Shark. However, Bose's selection of a genotype antedates Fowler's, and the interpretation of *Carcharhinus* I have given above appears to be the correct one.

Family GALEIDÆ.

The genera of Grey Sharks have been listed in Jordan's "Classification of Fishes," 1923, p. 100, and only a few additions are to be noted, as follows:—

Galeolamna Owen, Deser. Cat. Osteol. R. Coll. Surg. i, 1853, p. 96, no. 427. Haplotype, *G. greyi*, Owen, from South Australia. *Id.* Whitley, Rec. Austr. Mus. xviii, 1932, p. 324. At present indeterminate.

Hemistriakis Herre, Philippine Journ. Sci. xxiii, 1, 1923, p. 71. Orthotype, *H. leucoperiptera* Herre, from Dumaguete, Philippines.

Rhizoprionodon Whitley, Austr. Zool. v, 1929, p. 354. Orthotype, *Carcharias* (*Scoliodon*) *erenidens* Klunzinger. Substitute for *Rhizoprion* Ogilby, preocc.

Negogaleus Whitley, Austr. Zool. vi, 1931, p. 334. Orthotype *Hemigaleus microstoma*, Bleeker. Substitute for *Hemigaleus* Bleeker, preocc.

Notogaleus Whitley, Austr. Zool. vi, 1931, p. 310. Orthotype, *Galeus australis* Macleay.

The genera of Galeidæ may be conveniently divided into subfamilies, although *Scylliogaleus* deserves family rank. I would restrict *Galeus* and its allies to the Galeinæ and separate other subfamilies as Galeocerdinæ and Loxodontinæ. Then the genera allied to the *Carcharhinus* of authors (not of Blainville, s. str.) would enter the subfamily Scoliodontinæ, and it is to this group that the Queensland Grey Sharks belong. The identification of the genera is assisted by the keys given by Gill (Ann. Lyceum Nat. Hist. N. York vii, 1862, p. 399–400) and Ogilby (Mem. Qld. Mus. v, 1916, pp. 90–95).

The "*Carcharhinus*" of Ogilby is no longer valid and requires subdivision, wherefore I propose *Mapolamia*, gen. nov. for *C. melanopterus* Quoy and Gaimard, and *Gillisqualus* gen. nov. for the Queensland Shark identified by Ogilby as *Carcharhinus amblyrhynchos* Bleeker. I have considered our Whaler Sharks as perhaps belonging to the genus *Galeolamna* of Owen, but more detailed research has convinced me that the status of Owen's name is at present indeterminate, so I provide *Galeolamnoides* gen. nov. for *Carcharias macrurus* Ramsay and Ogilby, the Whaler Shark of New South Wales.

Subfamily SCOLIODONTINÆ.

Genus SCOLIODON Müller and Henle, 1837.

Scoliodon Müller and Henle, Ber. Verh. K. Pr. Akad. Wiss. Berlin 1836 (1837), p. 114; Arch. Naturgesch. (Wiegmann) iii, 1, 1837, p. 397; Mag. Nat. Hist. (Charlesw.) ii, 1838, p. 35. Logotype, *Carcharias laticaudus* Müller and Henle. *Id.* Ogilby, Mem. Qld. Mus. i, 1912, p. 27.

SCOLIODON JORDANI Ogilby.

(Text-figures 2 and 3).

- Carcharias acutus* Ogilby, Cat. Fish. Austr. Mus. i, Palæichth., July 1888, p. 1, and Proc. Linn. Soc. N. S. Wales (2) iii, 1889, p. 1766. Burnett River, Queensland. Specimen in Austr. Mus. seen. Not *C. acutus* Rüppell, Neue Wirbelth., Fische, 1837, p. 65, pl. xviii, fig. 4, from the Red Sea.
- Scoliodon jordani* Ogilby, Ann. Rept. Amat. Fish. Assoc. Qld. 1906-7 (July 1907), p. 12. *Nom. nud.* *Id.* Ogilby, Proc. Roy. Soc. Qld. xxi, 1908, p. 88. Outer Caloundra Bank, South Queensland; 25 fathoms. Type lost.
- Scoliodon affinis* Ogilby, Mem. Qld. Mus. i, Nov. 27, 1912, p. 29, *et. ibid* v, 1916, pp. 79 and 94. Noosa Head, Queensland. Holotype (No. I. 1526) in Queensland Museum examined.
- Scoliodon longmani* Ogilby Mem. Qld. Mus. i, Nov. 27, 1912, p. 30 *et. ibid* v, 1916, pp. 80 and 94. Moreton Bay, Queensland. Holotype (No. I. 292) in Queensland Museum examined.

The type-specimen of *Scoliodon jordani* cannot now be found in the Queensland Museum, the "Endeavour" collections, or the Australian Museum, though the jaws may be preserved amongst those in the Amateur Fisherman's Association of Queensland's collection, though not labelled as such. Ogilby noted that he was present at the time this shark was captured so undoubtedly described it, with other fishes, aboard the "Endeavour," and did not retain the type.

The nominal species *affinis* and *longmani* have been fully described by Ogilby, but I do not regard the differences in the shape of the dorsal fin and the extent of the labial folds as sufficiently characteristic to distinguish more than one species. However, I now offer the first illustrations of the type-specimens so that other workers may judge for themselves.

The jaws and teeth have been removed from the type of *affinis* and the corners of the mouth have been cut away so that it is now impossible to distinguish the upper labial fold which Ogilby described as "very short and directed outwards at a right angle to the jaw."

As for the type of *longmani*, the specimen is curved and somewhat hardened so that it is difficult to represent it in side view. Measurements taken on one side of the specimen do not coincide with those taken on the other and thus may be explained any slight discrepancies between my figure and the original description by Ogilby. In any case, the pectoral fins of *longmani* do not reach "to below middle of first dorsal,"



(Text-figures 2 and 3.)

Scoliodon jordanii Ogilby. Upper figure, holotype of *Scoliodon affinis* Ogilby. Lower figure, holotype of *Scoliodon longmani* Ogilby.
Denticles and teeth drawn from the *longmani* specimen. * Southern Queensland. Gilbert Whitley del.

In the Australian Museum there is still preserved the foot-long specimen (Regd. No. B. 7028) recorded by Ogilby from the Burnett River, where Henry Smithurst obtained it in 1885. It has short labial folds, apparently intermediate in form between those of *affinis* and *longmani* and approaches the latter form in having the dorsal fin longer than high. A slightly larger female from Moreton Bay is also preserved in the Australian Museum (regd. no. I. 12621).

An ascarid parasite from a Townsville *Scoliodon* has been described by Baylis (Ann. Mag. Nat. Hist. (10) viii, 1931, p. 95 and figs.).

MAPOLAMIA, gen. nov.

Orthotype, *Carcharias melanopterus* Quoy and Gaimard.

Small sharks, rarely more than five feet in length, common inshore in tropical Pacific waters and easily recognised by the contrasted black tips to the fins. The genus may be defined as follows:—

General form of *Eulamia* but with the head broad and depressed and not more than one-fourth of the total length. Vent slightly nearer snout than tip of tail. Eye small, its longitudinal diameter greater than its vertical diameter; a well developed nictitating membrane. Snout rounded. Nostrils large, nearer eye than tip of snout, and with triangular flaps. Fifth gillslit smallest and situated over pectoral base. Labial folds very small. Teeth triangular, serrated, broader in upper jaw than in lower, in one or two functional series, those of the upper jaw notched and serrated. Tongue broadly rounded.

Body tapering. Caudal peduncle compressed, and with a slight dip above and below. Scales minute, forming rough shagreen.

First dorsal large, opposite the interspace between the paired fins. Second dorsal well developed, and opposite anal. Pectorals falciform. Ventrals opposite the long interdorsal space. Upper lobe of caudal fin notched. All the fins conspicuously bordered with black.

Generic definition drawn up from a male specimen, 21 inches long, from the Ellice Islands, Oceania. Austr. Mus. Regd. No. 1A-5523.

This genus is typified by the *Carcharias melanopterus* of Quoy and Gaimard (Voy. Uranic, Zool, 1824, p. 194, pl. xliii, figs. 1-2. Waigiou). These authors included the *Squalus carcharias minor* of Forskal and *Squalus ustus*, Dumeril as synonyms, but these are a distinct species, *ustus* Blainville 1816. *Squalus malapterus* Lesson (Dict. Class. Hist. Nat. v, 1829, p. 596), is the same as Quoy and Gaimard's name, which is probably again a synonym or subspecies of *Squalus spallanzani* Lesueur (Journ. Acad. Philad. ii, Nov. 1822, p.

351. Terre de Witt, New Holland) from North Western Australia. Thus the Black-tip Shark of the Queensland and Northern Australian coasts, ranging also to New Guinea and Oceania, should now be called *Mapolamia spallanzani* (Lesueur). The occurrence of *melanopterus* in Victoria was noted by McCoy (Ann. Mag. Nat. Hist. (3) xx, 1867, p. 183, Hobson's Bay, 15 feet!) but this is more likely to refer to a Whaler Shark (*Galeolamnoides macrurus* = ? *Galeolamna greyi*). Again, the Hawaiian form called *melanopterus* may represent a new subspecies, as it appears to differ from the type in the shape of the head, especially about the nostrils and mouth, and, to a less extent, in the relative position of its fins.

GILLISQUALUS gen. nov.

Orthotype, *G. amblyrhynchoides*, sp. nov.

Teeth compressed, erect, serrated in upper jaw and minutely serrated in lower jaw, the points not markedly deflected outwards. Spiracles obsolete. First dorsal originating over posterior part of pectoral base. General characters as described for the species. Differs from *Hypoprionodon* Gill 1862 mainly in having the teeth of the upper jaw serrated.

Named in honour of Theodore Gill, the great American ichthyologist whose taxonomic work on sharks and fishes resulted in a tremendous advance in the knowledge of their classification and nomenclature.

GILLISQUALUS AMBLYRHYNCHOIDES sp. nov.

(Text Figure 4.)

Carcharinus amblyrhynchos Ogilby, Mem. Qld. Mus. iii, 1915, p. 132, Cape Bowling Green.
Carcharinus amblyrhynchos Ogilby, Mem. Qld. Mus. v, 9, 6, pp. 81 and 94, Cape Bowling Green, Coast of North Queensland. Not *Carcharias (Prionodon) amblyrhynchos* Bleeker, Nat. Tijdschr. Ned. Ind. x, 1856, p. 467. Near Solombo, Java Sea.

C. amblyrhynchos was described by Bleeker, and Duméril added further details from Bleeker's manuscript but the species was unknown to Günther and to Garman and has apparently never been figured. Ogilby identified as *C. amblyrhynchos* the shark from Cape Bowling Green described below, but it does not agree with the typical description.

Head, measured to fifth gill opening (145 mm.) about one-quarter of the total length (about 600 mm.) Anterior margin of vent midway between snout and tip of tail. Head broader than high and longer than broad. Snout 38 mm. between parallels. Eye 13 mm. deep and 10 long. Interorbital 68, eye to first gill opening 69, internarial space 37, preoral length 45, gill openings 24/25/26/23/18, depth of body about 90.

Snout to first dorsal 185 mm; first dorsal base 70; first dorsal, height about 67; interdorsal space 113; second dorsal base 28, its height 18.5, caudal peduncle 39 or 34 behind anal fin. Lower caudal lobe (61) 2.7 in upper

lobe (165). Anal base 39, its height 27. Length of pectoral 95, but tips have been damaged.

Snout acutely rounded. Nostrils nearer eye than end of snout, the tips of the valves forming right angles and the width of the nostril equals the longitudinal diameter of the eye. Distance between nostrils about five-sixths of preoral length. The eye lies over the anterior part of mouth; pupil vertical and of lenticular form; nictitating membrane present. No spiracle. Last two gill openings closer together than others and overlying pectoral fin. Two lines of pores between eye and mouth and groups of pores on other parts of head. Mouth more than twice as wide as it is long (width 63 mm. and length of arc of lower jaw 35). A very small labial fold in upper jaw.



(Text-figure 4.)

Gillisqualus amblyrhynchoides Whitley.

Ogilby's specimen of "*Carcharhinus amblyrhynchos*" (*non* Blkr.), from Cape Bowling Green, Queensland. Q. M. regd. no. I 2003—*A* Lateral view of entire specimen, *B* ventral view of head, *C* dermal denticles, *D* teeth of upper jaw, near symphysis, *E* teeth of lower jaw, near symphysis. Gilbert Whitley *del.*

Dental formula $\frac{13. 1. 13}{11. 1. 11} = \frac{27}{23}$ Median teeth small, others long and

acutely pointed and with broad cusps; teeth noticeably serrated in upper jaw and minutely serrated in lower; two functional series, erect.

Habit gracefully fusiform, the body broadest just before the gills. Caudal peduncle rounded with a large superior and a smaller inferior lunate pit. Scales extremely minute,

First dorsal originating over posterior part of pectoral base. Pectorals rather short, and with rounded extremities, but they have evidently been damaged and the tips regenerated. In any case, they would not be nearly as long as the head and their length is about $1\frac{1}{2}$ times their width. Length of anterior margin of pectoral, from base to tip, less than distance between eye and last gill-opening; the adpressed fin does not quite reach the vertical of posterior angle of dorsal base (Ogilby says it reaches to below anterior third of first dorsal, but this is incorrect). Ventrals below interdorsal space. Second dorsal and anal almost opposite, the anal origin being almost imperceptibly posterior; the fins subequal. Upper caudal lobe notched.

Coloration in formalin, dull plumbeous, darkest on dorsal surface and on fins.

Described and figured from Ogilby's specimen of "*Carcharhinus amblyrhynchos*," the holotype of my new species, a female nearly two feet long.

Locality.—Cape Bowling Green, Queensland. Qld. Mus. Regd. No. I. 2003.

It differs notably from the descriptions of Bleeker's type in having much shorter pectorals and in having the first dorsal base longer than the height of that fin, and in having the snout acutely pointed rather than almost semi-circular. The proportions and coloration are different and the new species has triearinate dermal denticles. There are minor discrepencies as well which induce me to separate the present form as a new species.

GALEOLAMNOIDES, gen. nov.

Orthotype, *Carcharias macrurus* Ramsay and Ogilby = *Galeolamnoides macrurus*.

Upper teeth triangular, very oblique laterally, and serrated on both edges; their outer edges are more or less notched, the angle being very much greater in those on the sides than near the symphysis. Lower teeth narrow, erect, and more or less obscurely serrated. Snout rather long and rounded. Spiracles obsolete.

Dorsal fin entirely behind vertical of pectoral base. A detailed description and figure of the typical form has been given by McCulloch (Proc. Linn. Soc. N. S. Wales, xlii, 4, 1921, p. 457, pl. xxxvii, figs. 1-4).

GALEOLAMNOIDES STEVENSI (Ogilby).

Carcharhinus stevensi Ogilby, Ann. Qld. Mus. x, Nov. 1911, p. 37, and as *Carcharias* on p. 38. Bustard Bay and Nor-West Islet, Qld.

Carcharhinus stevensi Ogilby, Mem. Qld. Mus. v, 1916, pp. 80 and 94 (the Check List referred to below). *Id.* McCulloch, Austr. Zool. i, 7, 1919, p. 220. *Id.* Coppleson, Med. Journ. Austr. April 15, 1933, p. 458.

The late A. R. McCulloch made a sketch of a mounted specimen, in the Queensland Museum, which he tentatively identified as this species. In his card-index, he made the following MS. notes:—

"It is labelled as *C. spenceri* Ogil. from Moreton Bay, on the authority of Ogilby, but it cannot be that species according to his key in his Queensland Check-list, as the length from the vent to the end of the tail is much less than that from the vent to the tip of the snout. I regard it as *C. stevensi*, Ogil., but it differs from the description of that species in having the anal inserted behind the vertical of the middle of the second dorsal. The types of *C. stevensi* cannot be found in the Queensland Museum; they were first described as 164-187 mm. long but in the check-list these measurements are said to be centimetres. No other specimen appears to be preserved in Qld. Mus. which can be referred to either *spenceri* or *stevensi*.

"Compared with *melanopterus* and *amblyrhyncho[ide]s*, this specimen presents the following characters:—Length from middle of vent to tip of tail equal to distance from vent to about half-way between first gill opening and eye. Eye small, longer than deep, its horizontal diameter much less than its distance from the nostril, and about half the width of the widest gill opening. Length of anterior margin of pectoral fin from base to tip equal to the interspace between the eye and the posterior gill-opening. Preoral length equal to about $\frac{3}{4}$ width of mouth; snout broadly rounded. Darker above, light below; fins apparently uniform.

"This specimen agrees with Waite's figure of *C. brachyurus* (Rec. Austr. Mus. vi, pl. 39), and I believe them to represent the same species, whatever it may prove to be."

To the present writer this specimen appears to represent a northern form of the Whaler Shark. The teeth are small, those from middle of side of upper jaw serrated and somewhat notched.

Family SPHYRNIDÆ.

Genus SPHYRNA Rafinesque, 1810.

SPHYRNA LEWINI (Griffith).

(Plate XXVIII.)

Zygæna lewini Griffith, Animal Kingdom (Cuvier) x, 1834, p. 640, pl. L. "Off the south coast of New Holland," i.e., Sydney, New South Wales. Also spelt *Z. lewisii* by Bleeker, 1854, and *Z. leeuwini* by Günther, 1870.

Sphyrna zygaena Studer, Zool. Forsch. Gazelle iii, 1889, p. 263 (Moreton Bay, Queensland).

Sphyrna tudes Ogilby, Ann. Qld. Mus. ix, Oct. 1908, p. 4. Moreton Bay, Queensland, and Tweed Heads, New South Wales. *Id.* Borodin, Bull. Vanderbilt Mus. i, 1932, p. 69 (Southport, Queensland). Not *S. tudes* Müller and Henle, Syst. Plagiost. ii, 1839, p. 53 = *Zygæna tudes* Valenciennes, Mem. Mus. Hist. Nat. Paris ix, July 1823, p. 225, from Mediterranean, Cayenne, and Coromandel.

Cestracion tudes Ogilby, Mem. Qld. Mus. v, 1916, pp. 82 and 94 (South Queensland locs.).

Head (130 mm.) 4.4 in total length (580). Vent nearer tip of snout than that of tail. Head wider than long, the breadth of the "hammer" being 165 mm. Eye 14 mm. Interorbital 157 (below) to 160 (above the head).

Gill openings 15/20/20/19/13 mm. Preoral length 41, width of mouth 39, length of arc 22. Depth of body about 65 mm. Snout to first dorsal 170. First dorsal base 59, its height 80. Interdorsal 127. Second dorsal base 20, its height 11. Caudal peduncle 40. Upper caudal lobe rather more than 3 times length of lower. Pectoral fin 71. Anal base 29. Anal-caudal interspace 36.

Form elongate and tapering, the body broadest and deepest near first dorsal fin, if the lateral expansions of the head be excluded. Head hammer-shaped, the cephalic extensions sloping slightly backwards and the anterior margin of the head with five concave sinuations. Eye large with round pupil and nictitating membrane. Slit of nostril subequal to eye, valve small; an anterior groove runs a short distance along each side of the profile of the head. Numerous sensory canals and pores on head. First and second gill opening more separated than the others; the fifth is above the pectoral. Mouth almost semicircular, labial folds obsolescent. The teeth are erect, with their acute points directed outwards and number about 20 to 25 in each jaw; one series in function and median teeth smallest.

Lateral line conspicuous; a large lunate pit above and a smaller one below the caudal peduncle. Scales exceedingly minute, forming a satiny shagreen.

First dorsal elevated, arising behind vertical of pectoral base. Second dorsal originating over the first third of the anal whose base is one and a-half times as long as that of the second dorsal. Pectorals short and somewhat rounded. Ventrals small. Lower caudal lobe rounded; upper notched below. Caudal fin about one-third of length without hammer.

General colour, in formalin, brownish, lighter below. The margins of the fins with peacock blue and greyish iridescence.

Described and figured from the specimen recorded by Ogilby as *S. tudes*, a female, 23 inches long.

Locality.—Moreton Bay, Queensland. Qld. Mus. Regd. No. I. 740.

Distinguished from *Platysqualus* (Valenciennes) by the arrangement of the sensory organs and pores on the head³ and by general details of proportion, shape, etc.

A mask modelled after a Hammerhead Shark has been figured from Jervis Is., Torres Strait, by Meyer (K. Ethnogr. Mus. Dresden vii, 1889, pl. iii), and a shrine to this remarkable shark is mentioned in Frazer's Golden Bough (v, 1919, footnote 1 on page 139) from Torres Strait also.

³Lloyd and Sheppard, Proc. Zool. Soc. (London), 1922, iv, pp. 971-981, figs. 1-7, give an account of the anatomy of the head of a hammerhead shark.

Family SQUALIDÆ.

Genus SQUALUS Linné, 1758.

The Australian Dogfishes are perhaps not strictly congeneric with *Squalus acanthias* Linné, the genotype of *Squalus* selected by Jordan and Gilbert (Bull. U. S. Nat. Mus. iii, 16, 1882, p. 16). Synonyms of this genus have the same genotype and are: *Squallus* Seopoli, 1777; *Acanthorhinus* Blainville, 1816; *Acanthias* Eichwald, 1819; and *Carcharias* Gistel, 1848, preoccupied.

SQUALUS MEGALOPS (Macleay).

(Plate XXVII, fig. C.)

Acanthias megalops Macleay, Proc. Linn. Soc. N. S. Wales vi, 2, Sept. 12, 1881, p. 367. Port Jackson.

My friend, Mr. W. J. Phillipps, recently supplied a brief review of the Piked Dogfishes of New Zealand and Australia (N. Z. Journ. Sci. Tech. xii, 6, 1931, pp. 360-361), in connection with which it is of interest to reproduce the accompanying drawing by the late A. R. McCulloch of a Victorian example of *Squalus megalops*, 404 mm. long. Austr. Mus. regd. no. I. 10826.

FAMILY ISURIDÆ.

Genus ISUOPSIS Gill, 1862.

ISUOPSIS MAKO (Whitley).

Isurus mako Whitley, Rec. Austr. Mus. xvii, 1929, p. 101, New Zealand.

This is the Mako shark of the New Zealand fishermen and the Blue Pointer of Australia. I have examined specimens in the Museums of Sydney, Adelaide, and Wellington, and freshly caught examples.

Making allowance for shrinkage in preserved specimens, the Australian form seems more slender than the South African, *I. bideni* (Phillipps), and has a shorter snout; height of dorsal about $\frac{1}{4}$ head, slightly more than $\frac{1}{2}$ depth of body. A three-foot mounted specimen (Austr. Mus. regd. no. I. 2756) of the Blue Pointer from Manly, New South Wales, has depth 7 in total length. Eye 3 in snout. Distance from anterior border of eye to that of nostril 4 in distance from posterior margin of eye to first gill slit. Interocular width (67) longer than length of snout from level of anterior margins of eyes (81). Internarial space (46) 1.2 in distance from nostril to end of snout (58).

Lower caudal lobe (126) 1.24 in upper (157). Caudal peduncle not nearly twice as wide as deep. Depth of body more than 5 in length without caudal in mounted specimen. Second dorsal entirely in advance of anal.

Another specimen of *Isuopsis mako* from Rosa Gully, South Head, Port Jackson (a young male caught 15/10/30 on line over a sandy bottom) had the following characters:—

Dental formula $\frac{13 + 13}{13 + 13}$. Teeth in two functional series.

Total length 43 inches; depth $7\frac{1}{2}$ inches; head to last gill opening 14; head to first gill opening $10\frac{1}{2}$; eye 1 in.; snout $2\frac{5}{8}$; snout from level of anterior eye margins $3\frac{1}{4}$; snout from nostril $2\frac{1}{2}$; mouth $4\frac{1}{2}$; ant. teeth, lower jaw, $\frac{1}{2}$; ant. border of nostril to that of eye, $1\frac{5}{16}$; internarial space, $1\frac{3}{4}$; post. margin of eye to first gill slit, 6; interocular, $2\frac{3}{4}$; pectoral length $6\frac{3}{4}$; pectoral base $3\frac{1}{2}$; pectoral, inner length from middle of base, $7\frac{3}{4}$; first dorsal, height $3\frac{1}{2}$; first dorsal, base $3\frac{1}{2}$; termination of first dorsal to origin of second dorsal $12\frac{1}{4}$; second dorsal entirely in advance of anal. Origin of anal to that of ventral 8; ventral base 2. Clasper $1\frac{3}{4}$; axilla of pectoral to origin of ventral $12\frac{1}{2}$; axilla of pectoral to vertical of dorsal $7\frac{1}{2}$; upper caudal lobe 8; lower caudal lobe $6\frac{1}{2}$; width of caudal peduncle, including keel, 3; depth half-way between second dorsal and caudal about $1\frac{3}{4}$. Nostril above anterior border of jaw, when lip is retracted. Dorsal nearer pectoral than ventral but behind pectoral base. Precaudal pits above and below. Spiracle a minute black spot well behind eye. Weight $18\frac{1}{2}$ lb.

General colour very dark navy blue above, changing to dull greyish after death. Ventral surface whitish. Eye very dark grey. Shagreen rough, satiny. Five very wide gill slits, before the pectorals; the last two approximate and crowded by insertion of pectoral fin.

A head of a New South Wales specimen, preserved in spirit, has eye (22.5 mm.) 3.6 in snout (83).

$$\text{Dental formula } \frac{10 + 11}{10 + 10} = \frac{21}{20}.$$

Interocular width (64) 1.1 in length of snout from vertical of anterior margins of eyes (75). Internarial space (38) 1.5 in distance from nostril to end of snout (58). The snout in this specimen is much more acute than in others, a sexual character, according to Phillipps.

As regards the South Australian form, Mr. Herbert M. Hale has kindly supplied the following information (*in lit.*, 4/3/30):—

"The cast of the Blue Pointer illustrated by Waite in his Fish list and Handbook is not in this Museum, and I think it is in the Canterbury Museum. Fishermen state that the species is common in our waters but I have seen very few specimens. We have a cast of a small example; it is impossible to furnish accurate details of the dentition, but I have made the following measurements, all in mm.

Snout to mid-caudal region	..	..	..	1,300
Snout to ant. border of eye	..	..	..	110
Snout to level of ant. borders of eyes	..	..	..	100
Snout to first gill-slit	..	..	..	300
Interorbital space	..	..	..	90
Distance between nostrils	..	..	..	50

The nostrils are 10 mm. in advance, and 10 mm. above the level, of the anterior border of the mouth. The spiracle is apparently absent or minute. The specimen was caught by H. Kemp, in Moonta Bay, Spencer Gulf, South Australia."

Family HALSYDRIDÆ.

Genus HALSYDRUS Fleming, 1809.

(Plate XXIX: Figures 1-3.)

- Halsydrus* Fleming, Scots Mag. 1809, p. 7; Brewster's Edinb. Encycl. xi, 1817, p. 713, and Philos. Zool. ii, 1822, p. 380. Haplo type, *Halsydrus pontoppidiani* Fleming. Based on the "Sea Serpent" of Stronsay, Orkney Islands, which was later identified as a Basking Shark.
- Tetroras* Rafinesque, Carat. Ale. N. Gen. Spec. Sicil., April 1, 1810, p. 11. Haplo type, *T. angiora* Rafinesque (*fide* Jordan, Gen. Fish. i, 1917, p. 77).
- Tetnoras* Rafinesque, Analyse Nat. 1815, p. 93, *Nom. nud.* (*fide* Sherborn).
- Cetorhinus* Blainville, Bull. Sci. Soc. Philom. Paris, Aug. 1816, p. 121 (*fide* Sherborn). Haplo type *C. gunneri* Blainville = *Squalus maximus* Gunner = Linné (*fide* Jordan, Gen. Fish. i, 1917, p. 95).
- Selache* Cuvier, Règne Anim. ed. 1, ii, "1817" = Dec. 1816, p. 129. Haplo type, *Squalus maximus* Blainville = Linné. *Id.* Schinz, Das Thierreich (Cuvier) 1822, p. 220. *Id.* Cuvier, Règne Anim. ed. 2, ii, 1829, p. 396. *Id.* Lesson, Dict. Class. Hist. Nat. v, 1829, p. 597.
- Selanche* Jarocki, Zoologia, iv, 1822, p. 452 (*fide* Sherborn).
- Selachus* Minding, Lehrb. Naturg. Fische 1832, p. 52 (*fide* Sherborn). *Id.* Yarrell, Hist. Brit. Fish. ii, 1836, p. 296. *Id.* Pavesi, Ann. Mus. Civ. Stor. Nat. Genova xii, 1878, p. 416. Emend. pro. *Selache* Cuvier.
- Ceteorhinus* Agassiz, Nomencl. Zool. 1846, Index. Univ. p. 75. Emendation for "*Ceterhinus*" Blainville, 1816. Type, *Squalus maximus* Linné, by present designation.
- Polyprosopus* Couch, Hist. Fish. Brit. Is. i, 1862, p. 67. Logotype, *Squalus rashleighanus* Couch, selected by Jordan and Evermann, 1896, *Id.* Gill, Proc. Acad. Nat. Sci. Philad. 1864, p. 207.
- ? *Hannorera* Van Beneden, Bull. Acad. Roy. Belg., xxxi. 1871, p. 504. Orthotype, *H. aurata* Van Beneden (*fide* Jordan, Gen. Fish. iii, 1919, p. 360). *Id.* Smith Woodward, Cat. Foss. Fish. Brit. Mus. i, 1889, p. 429. Fossil Shark.

I have not seen Rafinesque's original description of *Tetroras*, but Jordan and Evermann, in 1896, note it as stating "Two dorsals; one anal; four gill openings; tail unequal, oblique; snout blunt; teeth rasp-like; a keel on each side of tail; eyes very small; gill openings rather large; length about 6 feet. Called *Angiora* at Palermo." They regard it as applicable to *Cetorhinus* but suggest that it may be a mélange of *Isurus* and *Heptranchias*, the latter now being called *Anciora* at Palermo. The rasp-like teeth and blunt snout, however, preclude *Isurus* and one hesitates to make scientific identifications on the treacherous basis of vernacular names, especially as *Heptranchias* has seven gill slits and the basking shark has only five, the last of which is sometimes overlooked by casual observers, hence the name *Tetroras*.

The earliest name for this genus appears to be *Halsydrus* Fleming, based on the famous "Sea-serpent" of the Orkney Is. which was later shown to be a basking Shark, *H. maximus* (Linné).

This large selachian was first recorded from Australia by McCoy, whose specimen I have seen in the Exhibition Building, Melbourne, besides a half-grown example from Williamstown, Victoria, in the National Museum, Melbourne. The South Australian Museum, Adelaide, has several specimens, including a magnificent cast of a very large example. The Australian Museum, Sydney, has the gill rakers of Waite's specimen from southern New South Wales and the teeth of another from Mungo Beach, near the Myall Lakes, New South Wales. Photographs of the latter specimen are here reproduced as this constitutes the most northerly Australasian record. The tail of this shark was about one-fifth of the total length which was 25 feet.

Our Basking Shark ranges from New South Wales southward to Tasmania and New Zealand and westward to the Great Australian Bight. Mr. W. J. Phillipps has kindly supplied the following Neozelanic localities:—near mouth of Wade River, Davenport; Whangaparaoa Peninsula ("every spring"); Kapiti Island, Wairoa, Makara, and off Wellington, New Zealand.

If the Australasian form prove distinct from the European, the name *Halsydrus maccoyi* is available for it (Barrett, Sun Nature Book iv, "Water Life," 1933, p. 13 *ex Tetroras maccoyi* Whitley and Phillipps M.S.).

LIST OF AUSTRALIAN SPECIES.

In conclusion, I offer the following list of the Sharks of Australia and New Zealand, with an indication, whenever known, of their size, breeding methods, and harmfulness or otherwise, to man. The distribution of the species will in most cases be found in McCulloch's "Check-List" and Phillipps' "Bibliography."

1. One-finned Shark, *Heptranchias dakini* Whitley. Length about three feet.
2. Seven-gilled Shark, *Notorynchus cepedianus* (Péron). Over 9½ feet. Regarded as harmful to man in South Australia (Waite), but not looked upon as dangerous in New Zealand (Phillipps).
3. Port Jackson Shark, *Heterodontus portusjacksoni* (Meyer). 4 feet. Oviparous; egg case without tendrils. Harmless.
4. Crested Port Jackson Shark, *Molochophrys galeatus* (Günther). About 4 feet. Oviparous; egg case with tendrils. Harmless.
5. Northern Catshark, *Hemiscyllium freycineti* (Quoy and Gaimard). About one foot. Oviparous. Harmless.
6. Epaulette Shark, *Hemiscyllium ocellatum* (Bonnaterre). Over 3 feet. Oviparous. Harmless.
7. Speckled Catshark, *Hemiscyllium trispeculare* (Richardson). Two feet. Oviparous. Harmless.
8. Brown-banded or spotted Catshark, *Chiloscyllium punctatum* (Müller and Henle). Over 2 feet. Oviparous. Harmless.
9. Collared Catshark, *Parascyllium collare* Ramsay and Ogilby. Nearly 3 feet. Oviparous. Harmless.
10. Rusty Catshark, *Parascyllium ferrugineum* McCulloch. 2½ feet. Probably oviparous. Harmless.

11. Southern Catshark, *Parascyllium variolatum* (Duméril). Three feet. Probably oviparous. Harmless.
12. Blind Shark, *Brachaelurus waddi* (Bloch and Schneider). About 3 feet. Ovo-viviparous (Waite, Rec. Austr. Mus. iv, 1901, p. 32, pl. iv).
13. Carpet Shark, *Orectolobus ornatus* (De Vis). Six or seven feet. Ovo-viviparous. May attack a wader or, when caught, may snap at a man.
14. Wobbegong, *Orectolobus maculatus* (Bonnaterre). Five to six feet. Similar to *O. ornatus*.
15. Ogilby's Wobbegong, *Orectolobus ogilbyi* Regan. Four feet. Probably like *O. ornatus* and *maculatus*.
16. Cobbler Shark, *Orectolobus tentaculatus* (Peters). Three feet. Feared by children in West Australia, but probably harmless.
17. Zebra Shark, *Stegostoma tigrinum* (Pennant). Six feet (or nine, according to Ogilby). Oviparous. Harmless.
18. Tawny Shark, *Nebrodes concolor ogilbyi* Whitley. Over 3 feet. Oviparous? Harmless.
19. Blue-grey Shark, *Heteroscyllium colcloughi* (Ogilby). Only known from the type, 1½ feet long. Harmless.
20. Black-spotted Catshark, *Aulohalaelurus labiosus* (Waite). Only known from the type, about 2 feet long. Doubtless oviparous. Harmless.
21. Spotted Catshark, *Scyliorhinus analis* (Ogilby). Over 2 feet. Oviparous. Harmless.
22. Gulf Catshark, *Scyliorhinus vincenti* (Zietz). Two feet. Oviparous. Harmless.
23. Sawtail Shark, *Figaro boardmani* Whitley. Two feet. Doubtless oviparous. Harmless.
24. Draughtboard Shark, *Cephaloscyllium isabella* (Bonnaterre). About 1 foot. Oviparous. Harmless.
25. Swell Shark, *Cephaloscyllium laticeps* (Dumeril). About 1 foot. Oviparous. Harmless.
26. Marbled Catshark, *Atelomycterus marmoratus* (Raffles). About 2 feet. Oviparous. Harmless.
27. Black Tip Shark, *Mapolamia spallanzani* (Lesueur). Rarely more than 5 feet, but Ogilby records 10 feet for "*Carcharhinus melanopterus*." Probably viviparous, and harmless.
28. Shark, *Galeolamna greyi*, Owen. Only known from jaws in the Royal College of Surgeons.
29. Graceful Shark, *Gillissqualus amblyrhynchoides* Whitley. About 2 feet; only known from type.
30. Ganges Shark, *Platypodon gangeticus* (Müller and Henle). Nine feet. Viviparous. Dangerous to bathers.
31. Grey Shark, *Platypodon menisorrh* (Müller and Henle). Over 5 feet. Viviparous. Not regarded as dangerous.
32. Whaler, or Cocktail, *Galeolamnoides macrurus* (Ramsay and Ogilby). Twelve feet. Viviparous. Known to attack man.
33. New Zealand Whaler, *Galeolamnoides brachyurus* Gunther. About 8 feet. Probably viviparous and dangerous.
34. Northern Whaler, *Galeolamnoides stevensi* (Ogilby). About 6 feet. Probably viviparous and potentially harmful. Type missing.
35. Estuary Shark, *Galeolamnoides spenceri* (Ogilby). Over 6 feet. Viviparous and probably dangerous. Type not traced.
36. Great Blue Shark, *Prionace glauca* (Linné). Twenty feet. Viviparous. May be dangerous.
37. Long-nosed Shark, *Hypoprion hemiodon* (Müller and Henle). No data. About 2½ feet.
38. Maclot's Shark, *Hypoprion macloti* (Müller and Henle). At least 3 feet; no data as to breeding, etc.

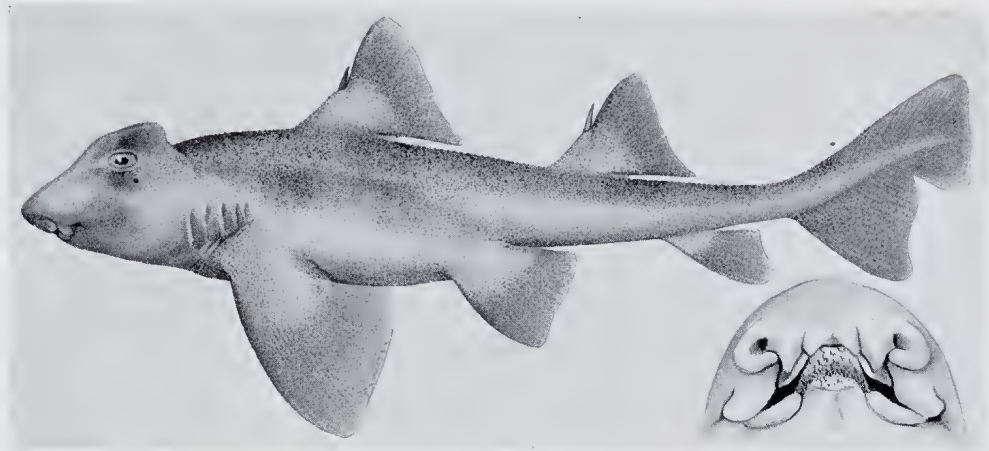
39. Jordan's Blue Dog Shark, *Scoliodon jordani* Ogilby. Type, nearly 3 feet long, lost. For synonymy, vide *supra*, in this paper.
40. Sharp-toothed Shark, *Aprionodon acutidens* (Rüppell). Over 6 feet.
41. Tiger Shark, *Galeocerdo rayneri* Macdonald and Barron. Over 16 feet. Viviparous. Known to attack man.
42. Northwestern Tiger Shark, *Galeocerdo curvier* (Lesueur). Probably like *G. rayneri*. See Journ. Acad. Nat. Sci. Philad. ii, Nov. 1822, p. 351, apparently a tiger shark.
43. Little Nurse, *Triakis scyllium* Müller and Henle. Two and a-half feet. Harmless.
44. School Shark, *Notogaleus australis* (Macleay). At least 6 feet. Viviparous. Not known to attack man.
45. Gummy or Sweet William, *Mustelus antarcticus* Gunther. Three and a-half feet. Ovo-viviparous, with a structure like a placenta. Harmless.
46. New Zealand Gummy, *Mustelus lenticularis* Phillipps. Probably like *M. antarcticus*.
47. Little Blue Shark, *Rhizoprionodon crenulens* (Klunzinger). Four feet. Harmless.
48. Muller's Shark, *Physodon mulleri* (Müller and Henle). No data.
49. Taylor's Shark, *Physodon taylori* (Ogilby). Type over 2 feet long, now missing.
50. Hammerhead Shark, *Eusphyra blochii* (Cuvier). Over five feet, probably much larger. Viviparous and perhaps dangerous.
51. Lewin's Hammerhead, *Sphyrna lewini* (Griffith). Ten feet. Probably viviparous. Harmless, so far as is known.
52. Large Hammerhead, *Sphyrna zygaena* Linné. Length over 15 feet or well over 400 lb. weight. Viviparous. Regarded as likely to attack man.
53. Mackerel Shark, *Lamna nasus* (Bonnaterre). Ten feet. Dangerous.
54. Mako or Blue Pointer, *Isuropsis mako* (Whitley). Twelve feet or nearly 800 lb. weight. Very savage and dangerous.
55. White Shark or White Pointer, *Carcharhinus carcharias* (Linné). Said to grow to more than 40 feet. A New Zealand specimen, 12½ feet long, weighed 910 lb. Dangerous.
56. Grey Nurse, *Carcharias arenarius* Ogilby. Fifteen feet; an 8-foot specimen weighed 370 lb. Viviparous. Dangerous to bathers.
57. Blue Nurse, *Carcharias tricuspidatus* Day. At least 12 feet. Probably viviparous and dangerous.
58. Thresher, or Fox Shark, *Alopias caudatus* Phillipps. Sixteen feet and over 900 lb. weight. Not regarded as harmful to man.
59. Goblin Shark, *Mitsukurina owstoni* Jordan. Length 7 feet.
60. Basking Shark, *Halsydrus maximus* (Linné). Over 35 feet. Harmless.
61. White-spotted Dogfish, *Squalus kirki* (Phillipps). Three feet. Harmless, but all the dogfishes may cause wounds by means of their dorsal spines.
62. Piked Dogfish, *Squalus megalops* (Macleay). Less than 3 feet. Ovo-viviparous; the spines of the embryo protected by knobs before birth.
63. Victorian Dogfish, *Squalus whitleyi*, Phillipps. Probably like the preceding species.
64. Dogfish, *Entoxychirus uyatus* (Rafinesque). The record of this species from Australia may be referable to a *Squalus*.
65. Prickly Dogfish, *Oxynotus brunensis* (Ogilby). Two feet. Harmless.
66. Plunket's Shark, *Proscymnodon plunketi* (Waite). Four feet. Viviparous. Harmless.
67. Thompson's Deepsea Dogfish, *Centrophorus kaikouræ*, nom. nov. pro. *C. calceus* Thompson (Rec. Canterb. Mus. iii, 4, 1930, p. 275, pl. xlii, figs. a-i), not of Lowe. Nearly 4 feet. The species of *Centrophorus* are harmless deepsea sharks and of the breeding habits in Australia or New Zealand little is known, though all are probably viviparous.

68. Nilson's Deepsea Dogfish, *Centrophorus nilsoni* Thompson. Three and a-half feet.
 69. Waite's Deepsea Dogfish, *Centrophorus waitei* Thompson. About 1 foot long.
 70. Deep-sea Dogfish, *Centrophorus harrissoni* McCulloch. Nearly 3 feet.
 71. Endeavour Dogfish, *Centrophorus scalpratus* McCulloch. Three feet.
 72. Long-snouted Dogfish, *Deaniops quadrispinosus* (McCulloch). Four feet. Probably viviparous. Harmless.
 73. Black Shark, *Scymnorhinus phillippsi* Whitley. Four feet. Viviparous (*see* Parker, Trans. N. Z. Inst. xv, 1882 (1883), pp. 222-234, pls. xxxi-xxxii). Harmless.
 74. Bramble Shark, *Echinorhinus (Rubusqualus) mccoysi* Whitley. Over 7 feet. Harmless.
 75. Luminous Shark, *Leius ferox* Kner. Type about 7 in. long, but grows larger. Harmless.
 76. Leiche, *Euprotomicrus bispinatus* (Quoy and Gaimard). Small and harmless. Recorded from New Zealand by Hutton on the basis of jaws which have since been lost (Phillipps).
 77. Sherwood's Shark, *Scymnodon sherwoodi* Archey. About 3 feet. Harmless.
 78. Frill-gilled Shark, *Chlamydoselachus* sp. Only known from Stead's identification of some decomposed remains from Port Jackson which do not appear to have been preserved.
 79. Angel Shark, *Squatina australis* Regan. Five feet. Viviparous. Harmless.
 80. Ornate Angel Shark, *Squatina tergocellata* McCulloch. About 1½ feet. Probably viviparous. Harmless. The New South Wales form belongs to a new subspecies.
 81. Saw Shark, *Pristiophorus cirratus* (Latham). Four feet. Viviparous, the rostral teeth of the embryo lie flat against the sides of the snout before birth. Harmless.
 82. Southern Saw Shark, *Pristiophorus nudipinnis* Gunther. Four feet, very similar to *P. cirratus*.
-



Heterodontus portusjacksoni (Meyer). A specimen, 550 mm. long, from Manly, New South Wales.
Austr. Mus. regd. no. I 9307.

[Drawing by Allan R. McCulloch.]



Molochophrys galeatus (Gunther). A specimen trawled off Sandon Bluff, New South Wales.
"Endeavour" Collection, no. E. 1760.

[Drawing by Allan R. McCulloch.]

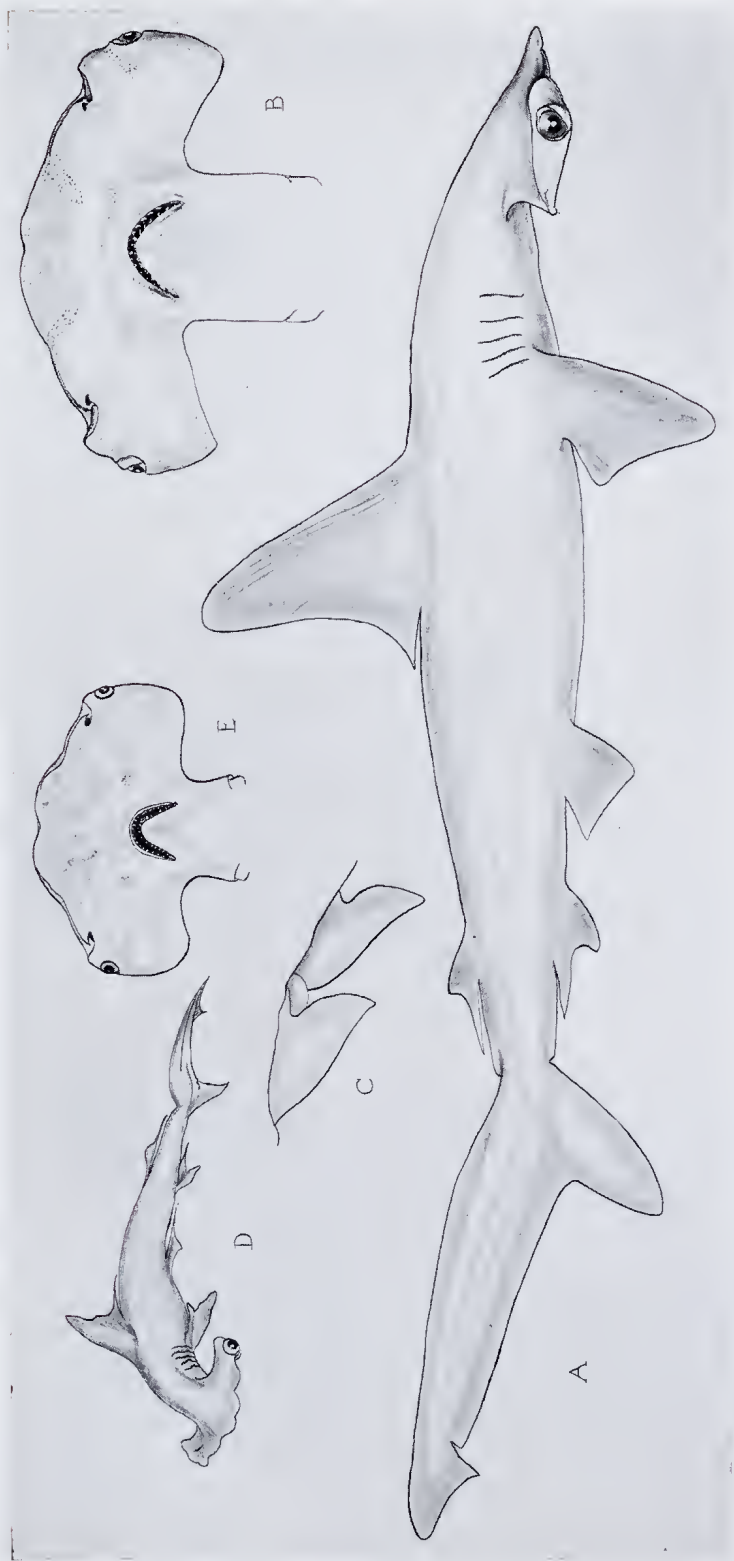


Squalus megalops Macleay. A specimen, 404 mm. long, from the coast of Victoria.

Austr. Mus. regd. no. I. 10826 (ex "Endeavour" coll.).

Face page 200.

[Drawing by Allan R. McCulloch.]



Sphyrna lewini (Griffith).

A.—Ogilby's specimen of "*Sphyrna tudes*" from Moroton Bay, Queensland. Qld. Mus. regd. no. I. 740.

B. Ventral surface of head of same specimen.

C. Teeth of same.

D. Type of *lewini* (after Griffith).

E. Type of *tudes* (after Valenciennes).

Joyce K. Allan del.]



Figs. 1. and 2. *Halsiadrus maximus* (Linné). A specimen, 25 feet long, washed up at Mungo Beach, New South Wales, in September 1930.

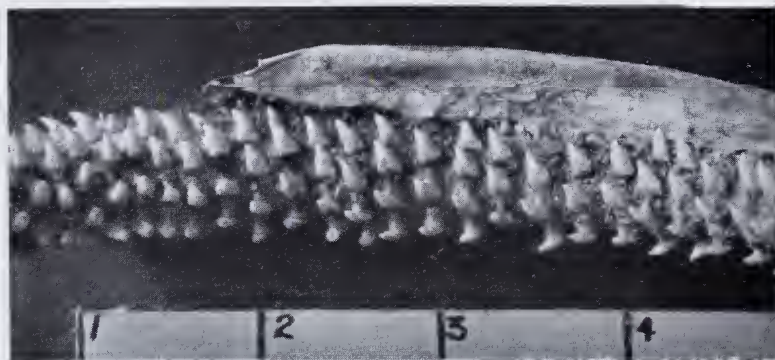


Fig. 3. *Halsiadrus maximus* (Linné). Some of the teeth of the same specimen with inch-rule for comparison.
Photographs: A. L. Marshall, Bullahdelah, N.S.W.

RESTORATION OF *EURYZYGOMA DUNENSE*.

BY HEBER A. LONGMAN, DIRECTOR, QUEENSLAND MUSEUM.

(Plates XXX-XXXI).

A restoration of *Euryzygoma dunense*, modelled by Mr. Wilfrid Morden, illustrated in Plates XXX-XXXI, has been placed on exhibition in the Queensland Museum. The remarkable cranium on which the genus *Euryzygoma* was established by the writer in 1921¹ was found at a depth of about 70 feet, during the sinking of a well on the property of Mr. G. A. F. Kleidon, Brigalow, Darling Downs. Supplementary material was recorded in 1929.² The specific name *dunense* was given by De Vis in 1887 to mandibles which he associated with *Nototherium*.

Although most attempts at reconstructions from incomplete remains are necessarily provisional and inadequate, the writer has pleasure in publishing illustrations of Mr. Morden's restoration of this very specialised and extraordinary marsupial. The outstanding features of the skull are the inferior lateral processes of the anterior part of the zygomata and the contours of the prominent suborbital platform. The maximum width of the skull (680 mm.) actually exceeds the maximum length (634 mm.), a most unusual characteristic among mammals. The lateral extensions relatively exceed the dependent processes of the malar in such Entelodonts as *Megachærus*, described by E. L. Troxell.³

In the original description, it was tentatively suggested that the extraordinary development of the zygomatic arches was associated with the presence of large cheek pouches, and no more satisfactory explanation of these curious processes can be made to-day. Although allied to species of *Nototherium*, *Euryzygoma* evidently represents a very specialised offshoot from this group of bulky herbivorous marsupials.

The restoration of the head was definitely built up on the actual contours of the fossil cranium (Plate XXX, fig. 2). Careful measurements were made and the proportions worked out in detail. The body contours are mainly based on the proportions of the skeletons of allied species of *Nototherium* with some reference to *Diprotodon*.

¹ 1921. Longman, Mem. Qld. Mus., vol. VII, pp. 65-80.

² 1929. Longman, Mem. Qld. Mus., vol. IX, p. 247.

³ 1920, Troxell, Amer. Journ. Sci., 4th ser., vol. 50, p. 433.

The restoration, which is approximately one-fifth natural size, involved much preliminary study and experiment, and warm appreciation is expressed of Mr. Morden's work.

PLATE XXX.

Figure 1.—*Euryzygoma dunense*. Head of Restoration by Wilfrid Morden.

Figure 2.—*Euryzygoma dunense*. Anterior view of Brigalow cranium.

PLATE XXXI.

Euryzygoma dunense. Restoration by Wilfrid Morden in Queensland Museum.



Figure 1. EURYZYGOMA DUNENSE; Head of Restoration, by Wilfrid Morden.



Figure 2. EURYZYGOMA DUNENSE; anterior view of Brigalow cranium.

Face page 202.



EDRYZGOMA DUNENSE. Restoration by Wilfrid Morden, in Queensland Museum.

A LARGE SPIRAL STRUCTURE FROM THE CRETACEOUS BEDS OF WESTERN QUEENSLAND.

By F. W. WHITEHOUSE, PH.D., M.Sc. (DEPARTMENT OF GEOLOGY, UNIVERSITY OF QUEENSLAND).

(Plate XXXII; Text-figures 1-4).

Explanation.—Mr. J. K. Ellis of Blackall recently forwarded to the Queensland Museum several portions of a large spiral object found by Mr. C. Catchlove and himself at a locality 8 miles north of Duthie Park homestead and about 25 miles east-north-east of Blackall. With it was sent a group of associated nodules. All these objects are now lodged in the collections of the Museum.

Description.—The spiral object, illustrated on Plate XXXII, figs. 1a, 1b, is not complete. When the several portions of it are put together a gap is noticed (indicated by a dotted line on the figure) where a section representing one or more whorls is missing.

The specimen, to this extent incomplete, is 203 centimetres long. The maximum width is 22.5 cms.

In form it is a dextral, helicoid spiral with 25 whorls preserved. The individual whorls are in contact and impressed at their junctions but they do not overlap. The whorls are approximately circular in cross-section except the end members in which a flattening takes place, while the external surface of each whorl is arched convexly. On the average the diameter of each whorl is approximately four times its length.

A very slight curvature is developed on what has been determined as the horizontal plane of the specimen.

At one end (the right-hand end in the figures on Plate XXXII) the final whorl is pillow-shaped, relatively large, and with its axis oblique to the maximum length of the specimen. The transverse diameter of each succeeding whorl is approximately normal to the general length. There is a noticeable decrease in the size of the whorls towards the middle of the specimen, after which a progressive increase in size takes place. At the opposite end the final whorl is unfortunately incomplete and abuts upon a mass of nodular structures. The seven whorls adjacent to this end have, on what would appear to be the lower surface, a shallow, transverse, median depression that is shown on Plate XXXII, fig. 1a.

Dimensions.—The following measurements were made upon the specimen. There is of course a variation in each individual whorl. The figures for the

length of each whorl were obtained by measurements along a line at about the middle of the lower surface. The measurements of the diameters of the whorls were made at right angles to the line. Whorl No. 1 is that shown at the right-hand side of the figure.

			Length of Whorl. (in cms.)	Diameter of Whorl. (in cms.)
1	..	..	15.8	..
2	..	..	9.5	22.5
3	..	..	9.2	20.7
4	..	..	8.5	17.0
5	..	..	6.4	18.1
6	..	..	8.3	18.1
7	..	..	7.7	18.0
8	..	..	6.3	16.8
9	..	..	7.5	16.1
10	..	..	5.6	16.2
11	..	..	7.5	17.0
12	..	..	7.0	16.0
13	..	..	5.4	16.6
14	..	..	7.4	17.2
15	..	..	4.9	18.4
16	..	..	8.1	19.9
Break			~~~~	~~~~
17	..	..	..	..
18	..	..	8.2	18.8
19	..	..	6.9	18.6
20	..	..	7.8	19.8
21	..	..	6.0	18.5
22	..	..	8.4	20.8
23	..	..	6.8	19.6
24	..	..	7.8	..
25	..	..	8.8	21.2

Composition.—Microslides have been made of the substance from each end and from about the middle of the specimen. These all agree in being a brown, calcareous sandstone with fontainebleau structure, and with the grains small in size, angular and composed mainly of quartz but with some fresh felspar fragments present. A certain amount of argillaceous matter is present also. This is one of the commonest rock types in the beds of the Great Artesian Basin.

Occurrence.—Along two opposite faces the specimen shows a slight grooving. On one side of this the surface is washed clear of extraneous matter. On the other side of the grooving the surface is covered with a structureless, white, calcareous substance identical with the precipitated lime deposits in the normal pedocalcic soils of this region. This suggests that the specimen has been embedded in the ground or in the rock up to the level of the grooving, the coated portion being thus the lower part. This pulverulent lime coating has nothing to do with shell substance; and it may be pointed out that nowhere on the surface of the whorls or in the impressed zone between them is there any trace of shelly calcareous matter.

The grooving is at an angle of 7° to the general length of the specimen. On Plate XXXII, fig. 1b the line of junction of the two surfaces may be seen starting from the base of the main break in the specimen and running upwards and to the right from that point. In this orientation the upper portion as shown on Plate XXXII, fig. 1b was the embedded side.

The Cretaceous beds of Western Queensland outcrop over vast areas of plains and dip at only very gentle angles. This angle of 7° on the specimen suggests that it was contained in the rocks lying along, or else at a very slight angle to the bedding plane.

Associated Structures.—Accompanying the specimen were masses of closely packed, flattened, nodule-like structures that Mr. Ellis in his letter appropriately compared to "a batch of buns." These are composed of similar brown, calcareous sandstone of the fontainebleau type. As has been mentioned the whorls at one end of the spiral abut upon a mass of such objects; but, unfortunately, owing to the specimen being there incomplete, the relationship of the spiral to the associated nodules is not to be determined.

Age.—Duthie Park is near the margin of the Great Artesian Basin in a region where the lowest beds (Roma Series) are overlapped by those of the Tambo Series. In this great basin of Cretaceous deposits the lower beds are of marine origin and are divisible into two series, the lower of Roma Series being of Aptian age and the upper or Tambo Series belonging to the Upper Albian (see Whitehouse 1928). Above the Tambo Series lies the Winton Series of non-marine beds and which, from available evidence, has a maximum thickness of at least 4,000 feet. The gradation from the Tambo Series to the Winton Series is complete. The lithology of the two Series is identical, the typical rock types being blue clays with bands of concretionary, calcareous sandstones. It is never possible in the field to place a line dividing the two Series; for the Tambo Series, so richly fossiliferous in its lower phase is, in its upper beds, almost entirely barren of fossils. Prolonged search in such upper beds of the Tambo Series may bring to light some fragments of *Inoceramus* or an *Aucellina*. With identical lithology in the two Series and a progressive decrease in the abundance of fossils in the lower it is usually impossible to say, in any pertinent area, where the marine Tambo Series ends and where begins the Winton Series, which has yielded plant remains from a few localities but never marine fossils. The work of Mr. C. Ogilvie and myself shows that, as a field guide, there are only two criteria that at present serve to distinguish definitely Tambo from definitely Winton Series beds. The typical concretions of the Tambo series are flattened, oval things ("Damper shaped"), while those of the Winton Series are usually spherical ("Cannon-Ball types"). Also, yellow shale pellets are common in the sandstones of the Winton Series but rare in such beds from the Tambo Series.

There are no fossils in the matrix of these specimens; but from their geographical position in the basin it would seem that the beds of Duthie Park

would be in the upper part of the Tambo Series or in the lower part of the Winton Series and so tentatively may be regarded as being of Cenomanian age.

Comparable Forms.—Three other groups of strange, large, spiral structures are on record. In 1892 Barbour recorded gigantic spiral forms from Miocene beds in Nebraska to which he gave the name *Daimonelix* (later changed to *Daemonhelix* by von Ammon). Similar forms recorded under this name have been found in Pleistocene beds in America (Wood & Wood, 1933) and in the Oligocene of Bavaria (von Ammon, 1900). On these forms there is now a considerable literature that has been summarised recently by Wood & Wood (1933).

In 1922 Woodward described some gigantic spirals, over seven feet in length, from the lower Wealden Beds (Wadhurst Clay) of England and, diagnosing the form as a gastropod, gave to it the generic name *Dinocochlea*.

A recent addition to our knowledge of these weird, giant spirals was made by Cox (1929) who figured a form dredged from the bottom of the North Sea.

In addition to these forms spirals of small size and of puzzling origin are known from many formations, paleozoic, mesozoic, and tertiary. References in literature to many of these have been given by Wood & Wood (1933, p. 830).

Daemonhelix reaches a length of many feet with a width of sometimes one foot. The spiral generally maintains a fairly uniform width. Both dextral and sinistral forms are known. It has a feature unique among such spiral structures, that near the base a long, straight, lateral process is given off from the main structure. Another feature of some interest is that occasionally in these forms an axial, cylindrical process is found.

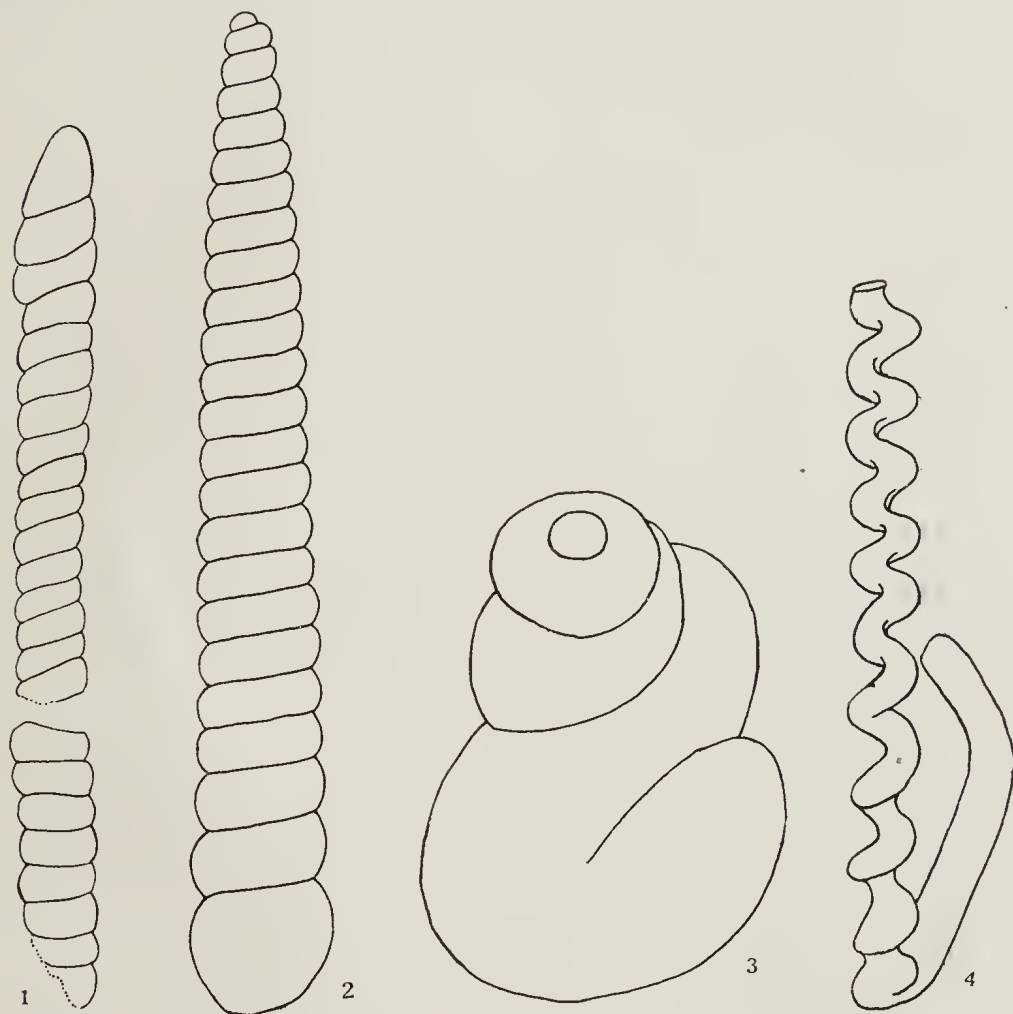
Among the spirals described as *Dinocochlea* both dextral and sinistral forms occur. Starting from a protoconch-like process the spiral slowly increases in width in a most regular manner, the increase corresponding to a logarithmic spiral.* The final whorl is considerably larger than any preceding. The very regular spiral and the appearance of the ends of the specimen temptingly suggest that the form is an internal mould of a gigantic gastropod of undetermined affinities. A coincidence that may be worthy of remark is that this form, like the Queensland specimen, is preserved in a calcareous sandstone with fontainebleau structure.

The mode of occurrence and the age of the North Sea specimen are of course unknown. Like *Dinocochlea* this is in the form of a widening spiral resembling a gastropod. It is, however, a more globular type and with fewer whorls than any of the other forms.

Dinocochlea and the present form agree in that they are embedded more or less in the plane of bedding of the rocks. *Daemonhelix* occurs in both vertical

* In one of these forms (a dextral specimen) Woodward (1922, p. 244) determined the ratio for the logarithmic spiral to be 1.02. For a sinistral form he quotes the ratio of 1.055.

and horizontal position. This new form and *Daemonhelix* are similar in that the spirals retain a general cylindrical shape. The other special features of *Daemonhelix* render more detailed comparison unnecessary. With *Dinocochlea*, however, the resemblances are closest. The two types differ in that the English form has a regularly widening spiral. In length they are comparable. Restored, the most



Text-figures 1-4. The several large Spirals. 1, The Queensland form. 2, The Wealden form (after Woodward). 3, The North Sea form (after Cox). 4, The Nebraska form (after Barbour). Figures one-eighteenth natural size.

complete English specimen has a length of 220 ems. The Queensland form is 203 ems. long but when complete would be somewhat greater than this. In this length of 220 ems. on the English form there are 23 whorls. The Queensland spiral has 25 whorls in a length of 203 ems.

The close comparison that is possible between the Australian and English

forms is of particular interest since both are from Cretaceous beds—*Dinocochlea* from the early part of the period and the new form apparently from near the middle.

Origin.—In attempting to explain the origin of such a spiral object it is necessary to summarise and to stress the following points:—

1. The structure is a relatively uniform helicoid spiral with no regular increase or diminution in size of whorls.
2. One end is bulbous suggesting that the structure was closed at that point. Unfortunately, the opposite end is not preserved.
3. No trace of an investing shell is to be found on the surface of the specimen or on the impressed zone between the whorls.
4. The object lay more or less in the plane of bedding in lacustrine or estuarine sediments of Cretaceous age.
5. The material of which it is composed is an arenaceous rock type common to Cretaceous sediments in the Great Artesian Basin.

Considering the great bulk of the specimen, the last of these premises suggests that the structure was formed either by concretionary action within an ordinary rock type or else by the infilling of a spiral cavity existing at the time of deposition of the beds.

The absence of any investing shell is important. In the marine beds of the Great Artesian Basin molluscs and other forms are very well preserved, and even with thin-shelled species it is rare to find an internal mould devoid of some traces of the shell. The fact that over the whole great surface of this spiral and in the impressed zone between the whorls there is no trace of any shell substance, renders improbable a suggestion that the specimen is an internal mould of an organism with a calcareous test.

As possible explanations of similar, large, spiral structures previously described, the following suggestions have been made by various authors:—

(A) An Inorganic Origin—

1. Infillings of potholes.
2. Concretions.

(B) An Organic Origin—

3. Internal moulds of Gastropods.
4. Coprolites.
5. Burrows.
6. Roots.

As Woodward (1922 p. 242) has pointed out for *Dinocochlea* the horizontal position of the specimen makes the suggestion of an infilled pothole untenable.

If it were possible to record a process producing horizontal, spiral structures in a concretionary way such an action would be the most favourable explanation of the origin of this form. Like *Dinocochlea* it occurs in a sedimentary series notably rich in concretions. As mentioned previously the

Winton Series in which it is developed is characterised by spherical concretions. A close, axial development of such spheres could lead to the production of a linear series of impinging, rounded, disc-like forms superficially similar in lateral view to this spiral. But I know of no method in which, by such means, a spiral coiling could be produced.

Woodward's suggestion of an internal mould of a giant gastropod, although capable of explaining the form of *Dinocochlea* and the North Sea specimen, is inadmissible for this spiral. There is no gradual increase in the size of the whorls; and the free end that is preserved suggests neither the proximal nor the distal end of a gastropod shell. Furthermore, considering the conditions of preservation, the absence of any trace of shell substance is opposed to such a conclusion.

Many coprolites, as Buckland (1835) long ago showed, are spiral things; and most of the giant spirals now discussed can be compared in superficial form with the small things figured by him. The great size of these spirals has been regarded as militating against such an origin. This is unreasonable; for both the Wealden and the Queensland spirals occur in beds where giant dinosaurs are known. *Austrosaurus mckillopi*, a dinosaur recently described by Longman from the Tambo Series, was estimated to be of the order of fifty feet in length (Longman, 1933, p. 142). With beasts of such size a coprolite of seven feet in length is possible. Some interest is added to this suggestion by the piled nodular masses associated with the spiral and conceivably of faecal origin. However, a serious objection to the coprolite theory is that the microslides show the minerals of a normal, arenaceous, sedimentary rock and have no fragments of fish scales or other organic matter—undigested food particles—that might be expected if it were a coprolite. It is possible, of course, and easy to imagine that the substance of a coprolite shortly after being embedded in a loose sediment could be dissolved away and the cavity so produced infilled by arenaceous sedimentary material. But it is difficult to conceive of this happening without some collapse of the walls, particularly on the upper surface; and the only deformation noticed on the specimen is slight and on what appears to be the lower surface.

Replaced root structures and the infilling of a burrow* are the theories most favoured to explain *Daemonhelix*. Each is capable of explaining the form of the Queensland spiral but neither can be proved. The closed end preserved on the specimen suggests that, if it be an infilled burrow, that end is the underground termination, and the other end should then be open. It is unfortunate that this end is incomplete. For the Wealden and the North Sea spirals, where both ends are preserved, the burrow theory is unlikely. If the Queensland form should be an infilled burrow the question arises what animal with a horizontally burrowing habit could dig the cavity.

* With *Daemonhelix* the burrow has been attributed to some form of rodent.

Two other coincidences may be noted about these spirals generally :—

1. The two forms most similar (the Queensland and the Wealden specimens) are comparable in age ;
2. Excluding the North Sea form the derivation of which is unknown, all these large spirals seem to occur in lacustrine or estuarine beds.

The first of these coincidences may suggest an organic origin—that the two forms are species of the one genus (*Dinocochlea*) of obscure relationships. If so, considering the Queensland evidence, Woodward's suggestion of a gastropod would be untenable. However, with only two occurrences for a problematical structure it would be unwise to stress this point of view

On the second coincidence too it is probable that little weight should be placed ; for the twofold form of *Daemonhelix* (the spiral and the lateral processes) suggests an origin different from that of the other and simpler forms.

Thus the problem of the origin of this spiral cannot be decided on the evidence available. No proffered explanation is free from grave objection, and it would be useless at present to press the claim of any one theory as a valid explanation of such a puzzling form.

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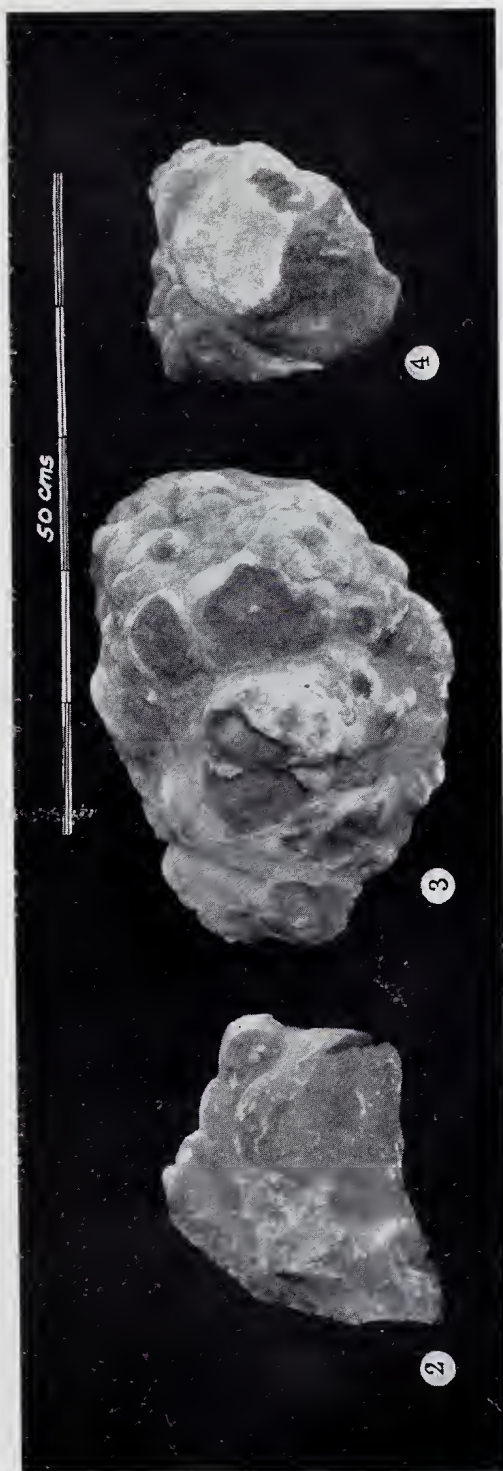
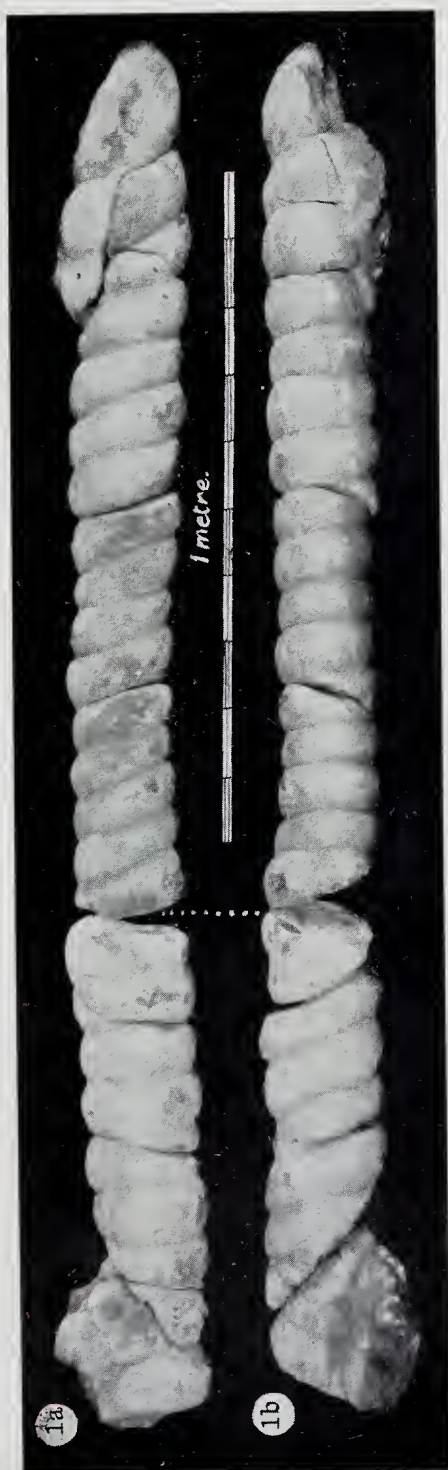
EXPLANATION OF PLATE XXXII.

Figs. 1*a*, 1*b*. Two views of the large spiral structure. (*a*) lower surface : (*b*) lateral view. The dotted line marks the break from which portion of the specimen is missing.

Figs. 2, 3, 4. Nodular masses associated with the spiral structure.

(Figures are reduced according to the scales shown.)

[End of Part IV. of Volume X, Memoirs of the Queensland Museum.]



SPIRAL AND NODULAR STRUCTURES FROM WESTERN QUEENSLAND.

Photographs: W. J. Sanderson.

